MSc Public Health Nutrition

Effects of socio-economic status on breastfeeding duration and exclusivity.

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Abstract

Aim: To assess socio-economic factors as predictors of breastfeeding duration and exclusivity.

Design: Longitudinal prospective study, The Prevalence of Infant Food Allergy Study.

Setting: Winchester and Eastleigh Primary Care Trust.

Subjects: 905 singletons born, data were collected by maternal interview and 12 month food diary.

Results: Overall breastfeeding was initiated by 91.4% of mothers, and by 1, 3 and 6 months of age the proportions being breastfed were 75.2%, 57.6% and 35.5%. By 1, 4 and 6 months of age the proportions being exclusively breastfed were 44.2%, 29.7% and 1.3%. There were clear socio-economic differences and mothers with a higher education were over three times more likely (OR 3.75, 95% CI 2.03-6.93) to initiate breastfeeding, two times more likely to be breastfeeding at 2 months (OR 2.71, 95% CI 1.59-4.62) and nearly twice as likely to be breastfeeding at 6 months (OR 1.96, 95% CI 1.05-3.67) compared to mothers with a lower education. Women with a higher education were also three times more likely to exclusively breastfeed for 2 months (OR 3.05, 95% CI 1.15-6.16) compared to mothers with a lower education. Exclusive breastfeeding was mostly lost due to the introduction of whey formula, with 91.43% of mothers in the low education group choosing to introduce whey formula first.

Conclusions: Low socio-economic maternal status reduced breastfeeding initiation, duration and 2 month exclusivity. Support for mothers with a low socio-economic status need to be established to improve breastfeeding rates in this population. Overall only 1.3% of babies were being exclusively breastfed. Mothers need to be properly prepared and supported if the WHO's 6 month exclusivity is to be met by the larger population.

Declaration of original work

"I hereby declare that work contained herewith is original and is entirely my own work (unless indicated otherwise). It has not been previously submitted in support of a Degree, qualification or other course."

Signed……

Date……..

Contents

List of figures

List of tables

Chapter 1. Introduction

Epidemiological research provides compelling evidence for the effect human milk has in decreasing the risk of infant mortality and morbidity from acute and chronic diseases (Horta, Bahl, Martines & Victora, 2007). In 2003 The World Health Organization (WHO) advocated breastfeeding as the best source of food for optimal infant growth and development. They recommended that infants should be exclusively breastfed, receiving no other foods or liquids besides breast milk except for medicine, vitamins or mineral supplements, until six months of age. This advice is still in place (WHO, 2008). Although there is a debate that infants exclusively breastfed for six months may be subject to energy and micronutrients deficiency (particularly iron and zinc) (Reilly and Wells, 2005), The Department of Health (DoH) and National Institute for Health and Clinical Excellence (NICE) have adopted the WHO's six-month exclusive breastfeeding recommendation.

The Infant feeding survey performed in 2005 (Bolling, Grant, Hamlyn & Thornton, 2007) showed that 78% of women in England breastfed their babies immediately after birth but, by six weeks, the proportion still breastfeeding had dropped to 50%. Only 26% of babies were still being breastfed at six months.

The 2005 survey was the first time that levels of exclusive breastfeeding at specific ages were measured, 45% of all mothers in the United Kingdom were breastfeeding exclusively at one week, while 21% were feeding exclusively at six weeks. The survey reported a negligible percentage of women (<1%) conformed with the six month exclusive breastfeeding recommendation of WHO.

The survey revealed that the highest incidences of breastfeeding were found among mothers from managerial and professional occupations, those with the highest educational levels, those aged 30 or over and first time mothers. Much research has

shown that the mother's social class influences breastfeeding initiation and duration, and breastfeeding trends have often been based on occupation related class categories (Skafida, 2008) with previous studies suggesting that breastfeeding is more common among privileged social classes (Kelly and Watt, 2005; Earland, Ibrahim & Harpin, 1997). This has very important implications for infant health, as breastfed babies are less prone to gastrointestinal tract infections and eczema (Kramer, Chalmers, Hodnett, Sevkovskaya, Dzikovich, Shapiro, et al., 2001). Moreover, there is now good evidence that breastfeeding is fundamentally important for long-term health (Royal College of Physicians, Faculty of Public Health Medicine, 1995). In addition to these studies which have looked at the importance of social class; a smaller number has looked at education as a predictor of breastfeeding with the level of education being shown as a strong predictor of breastfeeding (Scott, Binns, Graham & Oddy, 2006).

As level of maternal education has previously been over looked by other studies and is the less used socio-economic variable in predicting infant feeding practices, it was chosen as the socio-economic determinent in this study. Level of maternal education is an unmistakable and defined variable compared to the complicated 'social class'. Social class is a variable that could combine many factors such as; paternal occupation, household income and council tax bands. Determining the socio-economic status of each study participant would be very difficult to control for and a high amount of errors may occur. Level of maternal education was determined by one simple question "What is the highest level of education you have completed?" and study participants were easily given their education level and was used as a measure of socio-economic staus. This meant that any results seen in this study were controlled for and confident conclusions were made.

The data used in this study was from The Prevalence of Infant Food Allergy Study (PIFA), which was initiated in 2005, and is part of a large European Union funded project called Europrevall. PIFA looks in detail at infant feeding practices in the first year of life and how these may influence the later development of food allergies. This study used the first 12 months of PIFA data collected to assess whether socio-economic status will predict breastfeeding duration, exclusivity, and how exclusivity was lost. Acquiring information on the predictors of breastfeeding may better equip policy makers and public health practitioners in designing programmes for at risk groups and may help to bring the entire population closer to the infant feeding practices recommended by the Department of Health and WHO.

1.1. Study aim

To assess socio-economic factors as predictors of breastfeeding duration and exclusivity.

1.2. Study objectives

- To identify and evaluate the influence socio-economic factors have on breastfeeding duration.
- To identify and evaluate the influence socio-economic factors have on exclusive breastfeeding duration.
- To identify how exclusive breastfeeding status was lost.

1.3. Research question

Does a lower socio-economic status reduce breastfeeding duration and exclusivity?

1.4 Hypothesis

A low socio-economic status will reduce breastfeeding duration and exclusivity.

Chapter 2. Literature Review

2.1. Current recommendations

2.1.1. World Health Organisation and UNICEF

In 2002, the World Health Organization and UNICEF adopted the *Global Strategy for infant and young child feeding* (WHO, 2003). The strategy was developed to revitalise world attention to the impact that feeding practices have on the nutritional status, growth and development, health, and survival of infants and young children. Their global recommendations for optimal infant feeding as set out in the *Global Strategy* are:

- Exclusive breastfeeding for 6 months (180 days) (Kramer and Kakuma, 2001).
- Nutritionally adequate and safe complementary feeding starting from the age of 6 months with continued breastfeeding up to 2 years of age or beyond.

2.1.2. Department of Health

In 2003, the Department of Health published *Infant Feeding Recommendation* (DoH, 2003). The paper was designed to summarise the lasted advice to inform and assist health professionals supporting parents in optimising their infant nutrition. They recommended:

- Breast milk is the best form of nutrition for infants.
- Exclusive breastfeeding is recommended for the first six months (26 weeks) of an infant's life.
- Six months is the recommended age for the introduction of solid foods for infants.

- Breastfeeding (and/or breast milk substitutes, if used) should continue beyond the first six months, along with appropriate types and amounts of solid foods.

2.2. Government policy

The Department of Health have adopted a range of initiatives to promote breastfeeding. In 1988 they set up the joint Breastfeeding Initiative in England and Wales to encourage a closer working relationship between health professional and voluntary organisations to promote breastfeeding (Department of Health, 1988). In 1993 National Breastfeeding Awareness Week was launched and embraced annually; it highlighted the benefits of breastfeeding. 1995 saw the establishment of the National Network of Breastfeeding Co-ordinators. This group promoted breastfeeding at a local level. In 1999 the government pledged to improve health inequalities and part of that pledge was the Infant Feeding Initiative, projects across the county were developed which aimed to increase the incidence and duration of breastfeeding and focused on women that were at risk of not breastfeeding (Department of Health, 1999). The government in 2006 set a target of 2% increase of breastfeeding initiation per year and focused on disadvantaged groups to reach this. Of all initiatives the one which has drawn most widespread professional support has been WHO/UNICEF's Baby Friendly Hospital Initiative. The 'Ten steps to Successful Breastfeeding' has become the 'gold standard' for NHS Trust hospitals (WHO/UNICEF, 2003):

2.2.1. Ten steps to successful breastfeeding

Every facility providing maternity services and care for newborn infants should:

1. Have a written breastfeeding policy that is routinely communicated to all health care staff.
2. Train all health care staff in skills necessary to implement this policy.

3. Inform all pregnant women about the benefits and management of breastfeeding.
4. Help mothers initiate breastfeeding within half an hour of birth.
5. Show mothers how to breastfeed, and how to maintain lactation even if they should be separated from their infants.
6. Give newborn infants no food or drink other than breast milk, unless medically indicated.
7. Practise rooming-in - that is, allow mothers and infants to remain together - 24 hours a day.
8. Encourage breastfeeding on demand.
9. Give no artificial teats or pacifiers (also called dummies or soothers) to breastfeeding infants.
10. Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic.

2.3. The benefits of breastfeeding

The unified message coming from the international community of nutrition experts and health care professionals; that exclusive breastfeeding should be promoted during the first six months of an infant's life is based on extensive scientific research. Conclusions have been drawn on studies, which have shown breast milk as the best form of nutrition for infants and is sufficient for at least six months of life (Kramer and Kakuma, 2001). Breastfeeding is of vital importance in public health terms; in developed countries it is associated with decreased morbidity (Kramer and Kakuma, 2001, Oddy, Sly, Klerk, Landau, Kendall, Holt, et al, 2003) and mortality (Chen and Rogan, 2004) in infancy. It is now known that many constituents of human milk play multiple roles in the promotion of infant health and development (Lawrence, 1994). The health benefits of breastfeeding alone (which are discussed below), are a reason

why this studies results are so important. This study provides up to date information about infant feeding, such as who is breastfeeding and how long they are breastfeeding for? Who is not breastfeeding, and do any mothers actually exclusively breastfeed for the recommended 6 months? Knowing this information will equip the health services and its practitioners so effective promotion of breastfeeding can be established, and infants will have the health advantages that breastfeeding provides.

2.3.1 Breastfeeding and it's protective effect on infections

In the past, differences in morbidity and mortality between breastfed and formula fed infants were generally attributed to the differences in exposure to pathogens introduced through contaminated foods or fluids (Heinig and Dewey, 1996). While important this indirect protection is not the only means by which breast milk contributes to the health of the infant. The constituents of human milk enhance the neonate's immune system. It is reported that non-nutritive constituents provide direct protection against microbial pathogens, to modulate inflammatory processes and promote the growth and maturation of several organ systems (Goldman, Chheda, Keeney, Schmalstieg, & Schanler, 1994; Orlando,1995).

Kunz and Rudloff (1993), Goldman *et* al (1994) and Orlando (1995) describe the complex system of the antimicrobial factors that exist in human milk. These include (a) complex carbohydrates that inhibit binding of certain bacterial pathogens to epithelial cells; (b) nitrogen-containing sugars oligosaccharides (prebiotics) that promote growth of beneficial probiotics lactobacilli and bifido bacteria in the lower intestinal tract; (c) antibodies such as secretory IgA and serum IgG, which prevent binding and proliferation of pathogens and may actively prime the newborn's immune system; (d) anti-inflammatory agents; (e) antioxidants; *(f)* white blood cells such as neutrophils and macrophages; (g) lactoferrin, an iron binding protein that inhibits proliferation of iron requiring bacteria; (h) lysozyme, an enzyme that attacks microbial

pathogens; (i) antiviral lipids; and (j) antiprotozoan factors (adapted from Heinig and Dewey's critical review, 1996).

A number of papers have been published regarding the protective effects of breastfeeding against infection. They especially point to the protection exclusive breastfeeding provided against mild upper respiratory tract infections (Cushing, Samet, Lambert, Skipper, Hunt, Young, et al ,1998; Wright, Holberg, Taussig, & Martinez, 1995), inflammation of the middle ear (ortitis media) (Owen, Baldwin, Swank, Pannu, Johnson, & Howie,1993; Ball, & Wright,1999) urinary tract infections (Pisacane, Graziano, Mazzarella, Scarpellino, & Zona, 1992) and diarrhoeal illness (Popkin, Adair, Akin, Black, Briscoe & Flieger, 1990). The evidence that breastfeeding is protective against infectious disease is greatest for diarrhoeal illnesses. In 1984, the World Health Organization published a review of 35 studies examining the relationship between breastfeeding and diarrhoeal disease in developing countries (Feachem & Koblinsky, 1984). Breastfeeding was protective in 88% of those studies. Infants receiving no breast milk in the first months of life were 3.5-4.9 times more likely to suffer from diarrhoeal disease than infants who were exclusively breastfed.

2.3.2. Sudden infant death syndrome

Sudden infant death syndrome (SIDS) was first formally defined in 1969, as the sudden and unexpected death of an apparently healthy infant whose death remains unexplained after autopsy, examination of the death scene, and review of the case history (Valdes-Dapena, 1991). An infant not being breastfed is stated as an important risk factor for SIDS (NHS, 2009). Research has shown that breastfed infants have a lower risk of dying from SIDS (Ford, Taylor, Mitchell, et al, 1993) compared to formula fed infants. Alm and colleagues (2002) examined 244 cases of SIDS from Scandinavia; they found that short-duration of breastfeeding (less than 4

weeks) increased risk of SIDS by 5.1 fold, compared to breastfeeding for longer than 15 weeks. The potential mechanisms for an association between infant feeding and SIDS are still been thoroughly investigated. Because SIDS has been associated with infectious agents including infant botulism (Arnon, 1983; Blackwell, Saadi, Raza, Weir, & Busuttil,1993; Saadi, Blackwell, Raza, James, Stewart, Elton, & Weir, 1993), it is possible that the protective effect of breastfeeding is related to the immunological components of breast milk. Alternatively, breastfeeding may reduce infant risk for SIDS because breast fed infants have shorter periods of uninterrupted sleep and lower exposure to agents that cause anaphylactic reaction (Bernshaw, 1991).

2.3.3. Obesity

The rising prevalence of obesity among children in developed countries coincided with widespread rejection of breastfeeding (Langley-Evans, 2009), and has led to a multitude of research asking if early life nutrition has contributed to childhood obesity. Arenz and colleagues (2004) performed a systematic review of the literature published between 1966 and 2003 to address the possible association between breastfeeding and childhood obesity, the results indicated that risk of obesity in childhood is reduced by 22% by breastfeeding compared to formula fed infants. Langley-Evans (2009) explained a number of acknowledged mechanisms that have been suggested to explain the protective effect of breastfeeding:

- *"Bottle-feeding leads to an earlier adiposity rebound. BMI in children normally increases rapidly in the first year of life and then declines reaching a minimum point around age 5-6, before rising again. The point of minimum BMI is termed the adiposity rebound point. Early adiposity rebound is predictive of obesity later in life."*
- *"Breastfeeding is demand led and the infant controls energy intake. With bottle feeding, loss of infant control over intake causes the normal*

hypothalamic regulators of the appetite to develop in a way that favours excess intake in the longer term."

- *"Bottle fed infants have higher plasma insulin concentrations than breast fed infants. This favours early deposition of fat and an increase in fat cell number.*
- *Human milk contains bioactive factors that maintain a pattern of growth that favours a leaner body mass."*
- *"The lower ratio of n-3 to n-6 fatty acids in formula milk compared to human milk promoted adipose tissue development."*

2.3.4. Allergy

It has been suggested that breastfeeding may have a protective influence on the development of allergies in children, which will most commonly manifest as either atopic dermatitis (allergic eczema) or asthma (Oddy, Holt, Sly, Read, Landau, Stanley, Kendall, & Burton, 1999). The main reasoning here is that formula feeding generally involves exposure of the infant to cow's milk proteins at an early stage of development (Esfarjani, Azar, & Gafarpour, 2001). Allergies to cow's milk proteins are among the most common food allergies noted in children (Wood, 2003). Breastfeeding prevents this early exposure to cow's milk protein but could also be beneficial since human milk provides passive immunity and promotes the development of the infant immune system (Hanson, 2007). Atopy, a tendency to develop allergies, is strongly associated with genetic components and research by Kramer and colleagues (2001) reported a 46% decrease in risk of atopic dermatitis when children were exclusively breast fed for 3 months. In children with a family history of atopy, the benefits of breastfeeding are clear, with significant reductions in childhood eczema associated with breastfeeding for up to 4 months. Kerkhof et al (2003) reported that in the children of women with a history of allergic asthma, breastfeeding for 13 weeks or more reduced prevalence of atopic dermatitis by 40%.

2.3.5. Bonding

Breastfeeding is seen as an important stage of an early and healthy bond between mother and infant. The act of feeding involves close physical contact and eye contact (termed mutual gazing), which is suggested to increase the quality of the mother-child relationship (Langley-Evans, 2009).The mother's anxiety is effectively reduced through the secretion of oxytocin and so increasing activity of the parasympathetic nervous system (Mezzacappa, 2004). This helps the mother develop the emotional bond with her child and promotes her sensitivity to the needs of the infant (Langley-Evans, 2009).

2.3.6. Cognitive development

In several large studies, children who had been breast fed had a small but statistically significant advantage over those who had been artificially fed in scores attained on a variety of cognitive tests. In a meta-analysis (Anderson, Johnson, Remley, 1999) of 20 studies of children whose cognitive function had been tested between infancy and adolescence, breast feeding was associated with significantly better cognitive performance. The benefit seemed to increase with increasing duration of breastfeeding and was greatest in those whose weight at birth had been low.

The health benefits listed are all seen in infants that have been exclusively breastfed, and the WHO state, to benefit from these health effects, it is recommended to exclusively breastfeed for 6 months, but research shows that these health benefits as mentioned can be seen in infants that have been partially breastfed.

2.4 Health of the mother

Breastfeeding an infant carries a number of advantages for the mother's short and long term health. Breastfeeding increases levels of oxytocin a hormone that

stimulates the breast to release milk (Gimpl, Fahrenholz, 2001), oxytocin also increases uterine involution and reduces the risk that the mother will suffer a postpartum haemorrhage because the uterus is a target for actions of oxytocin (Langley-Evans, 2009). Suckling inhibits the production of follicle stimulating hormone and luteinizing hormone from the anterior pituitary. This lactational amenorrhea confers two benefits. Firstly, reduced blood losses help to preserve iron stores and hence leads to a more rapidly recovery of normal iron status after pregnancy. Secondly, lactational amenorrhea acts as a natural form of contraception (Dermer, 2001), as it helps to space out pregnancies. This has a number of benefits for maternal health, allowing full recovery between successive pregnancies, and in turn reduces the likelihood of children being of low birth weight and hence at greater risk of neonatal mortality.

Evidence is emerging that suggests the risk of cancer is lower in women who breastfeed their infants. Danforth and colleagues (2007) carried out an analysis of the two US Nurses Health Studies, which included approximately 150,000 women who had children. Risk of ovarian cancer for women that had breastfed was reduced by 14% compared to women who had never breastfed. The Collaborative Group on Hormonal Factors in Breast Cancer (2002) examined data from 47 epidemiological studies including 50,302 women with breast cancer and 96,973 controls across 30 different countries. The data showed that with each year of breastfeeding, breast cancer risk was reduced by 4.3%. These benefits appear small but applying this data to breastfeeding prevalence and duration rates in developed countries suggests that a high proportion of the difference in breast cancer prevalence between developed and developing countries might be explained by infant feeding practices. The study suggested that if children in developed countries were breastfed for 6 months longer, 5% of breast cancers (25,000 cases) would be prevented.

2.5 Trends and rates

Despite the numerous beneficial health effects for both the mother and her infant, the incidence and duration of breastfeeding in the UK is low, with the majority of babies in westernized countries bottle-fed with artificial formula preparations (Bolling et al,, 2007). In general, rates of breastfeeding have been increasing across the western world over the last two decades (Langley-Evans, 2009), as increasingly women become aware of the positive impact this has on the development of their babies.

In the UK, increases in rates of breastfeeding were noted between the mid 1970's and the 1980's, taking overall numbers of babies who were ever breastfed to around 65% of the population. Since then, these figures have shown a relatively stable increase with the 2000 Infant Feeding Survey (Hamlyn, Brooker, Oleinikova & Wands, 2002) finding 69% of British babies were ever breastfed and the 2005 Infant Feeding Survey (Bolling et al, 2007) found an encouraging 78% of babies were ever breastfed (these percentages only refer to an infant that has been breastfed on at least one occasion). So while breastfeeding is initiated by a large percentage of women, the dropout rate is very high and the 2005 survey showed the number of infants who were exclusively breastfed at one week dropped to 45%, at six weeks a further decline to only 21% and by six months of age less than 1% of women were exclusively breastfeeding their baby (Bolling et al, 2007). The observation that large numbers of women initiate breastfeeding but soon switch to bottle feeding or mixed feeding approaches provides a major clue to the fact that breastfeeding can be very difficult for many women to sustain. What is unique about this studies data is that it was possible to work out for each mother who exclusively breastfed at birth and exactly what, after breast milk they first gave their baby. As an objective this study identifies how and when mothers lose exclusivity. Having a better understanding of the nature of exclusive breastfeeding can only improve the chances of successful breastfeeding rates in the UK.

Marked inequalities are apparent in breastfeeding. Mothers most likely to initiate breastfeeding are those who reach higher educational levels, are in Social Class I or II, are aged over 30 years and are feeding their first as opposed to subsequent babies (Hamlyn et al, 2002). Langley-Evans and Langley-Evans (2003) surveyed 300 women from Northampton in their final trimester of pregnancy, the data showed that among higher social classes, the intention to breastfeed was indicated by a number of women that was well above the national average (80-90%), while only 50-60% of single mothers and women of lower social-economic class indicated that they would breastfeed their babies.

This study aims give an insight into infant feeding practises in the first year of life. The findings of the study could help advise the government and the NHS about how children are actually being fed in their first year of life. The results could be used as a guidline; seeing if there has been improvments with the uptakes of breastfeeding compared to the Infant Feeding Survey (Bolling et al, 2007) of 2005 and wether WHO's six month exclusivity recomendations are being met by a UK population.

What this study brings which is different to other UK studies looking at breastfeeding duration (Bolling et el 2007; Kelly & Watt, 2004; Wright, Parkinson & Scott, 2005; Skafida, 2008; Hawkins, Griffiths, Dezateux, Law & Millennium Chort Study Group, 2007) is that this study was able to collect data on when and what stopped exclusive breastfeeding whether it being type of formula e.g whey or follow-on, liquid or solid e.g. baby rice or puree vegetables. Providing information on loss of exclusivity is vitial in knowing how to encourage mothers to exclusively breastfeed for longer.

The study focuses on a number of factors that could have an effect on breastfeeding, such as educational attainment, maternal age, smoking status, parity and the type of area where the mother lives. Findings that prove socio-economic

disadvantaged mothers are particularly low in the initiation and duration of breastfeeding and its exclusivity have clear implications: at the start of their lives, infants from socio-economic disadvantaged families will be at a higher risk of several diseases. Therefore a public health strategy could be evolved from the study, helping to promote and educate these subgroups about the benefits of breastfeeding for both mother and child.

Chapter 3. Methods

3.1. Study design

This study was a longitudinal prospective cohort design over a 12 month period, beginning at birth.

The data used is from the PIFA Study (Prevalence of Infant Food Allergy), which was part of a large European Union funded project called Europrevall. A total of 12,000 infants and their families will participate in Iceland, Great Britain, Germany, Poland, Greece, Holland, Lithuania and Spain. 1200 infants were recruited in the UK and followed up for 24 months. The Europe wide aim of Europrevall is to:

> *"deliver improved quality of life to food allergy sufferers by developing knowledge-based holistic approaches to managing the problem of allergy. One aspect of this is to establish the patterns and prevalence of food allergies across Europe in infants (birth cohort studies)" (Europrevall, 2005)*

In addition to this, PIFA is also looking in detail at infant feeding practices in the first year of life and how these may influence the later development of food allergies. This MSc dissertation used the first 12 months of PIFA data collected to assess whether socio-economic factors have an effect on the duration and exclusivity of breastfeeding.

3.2. Recruitment

Sampling Frame: Pregnant women within Winchester and Eastleigh Primary Care Trust (PCT) were recruited over an 18 month period.

Sampling Strategy: A number of recruitment methods were utilised to introduce the study to pregnant women. Prospective study participants who had expressed an

interest in taking part were then contacted by telephone and had the study explained to them in more detail and answered any questions. If the pregnant women were agreeable, a recruitment appointment was arranged to take place.

Recruitment was not allowed to take place in labour wards as the ethics committee thought this could lead to coercion.

The aim of the PIFA study is to recruit subjects who were representative of the whole population to ensure results can be extrapolated. To encourage women from lower socio-economic groups onto the study, pre-paid taxis and home visits were arranged for some recruitment appointments.

3.2.1. Inclusion criteria

- Intended delivery at The Royal Hampshire County Hospital, Winchester, Andover birth centre and home births taking place within Winchester & Eastleigh PCT.
- Gestational age 34 weeks or above.
- Apgar score of 7 or greater at 5 minutes.
- Written informed consent from the newborns mother.
- Children under 16yrs were eligible for inclusion.

3.2.2. Exclusion criteria

- Gestational age <34 weeks (pre-term infants).
- Apgar score <7 at 5 minutes.
- Mother does not have the verbal, written or mental ability to understand the intent and character of the study.
- Lack of written consent.

- Participation in interventional studies investigating atopy and allergic disease.

3.3. Informed consent

Once initial interest and contact details were obtained, participants were sent a study information sheet (see Appendix A) prior to consent being taken at a pre-arranged interview. The participant had up to 3 weeks to decide whether they wished to take part in the research. At the initial interview any questions arising from reading the information sheet were answered and then written consent was obtained by a member of the research team from the pregnant women who were consenting for herself and her child (see Appendix B). Locally available translation services were available when requested for participants who did not adequately understand verbal explanations or written information in English, or had special communication needs.

3.4. Measurements

3.4.1. Outcome assessment

Food diaries were used to assess initiation, breastfeeding and exclusive breastfeeding duration (weeks) and how exclusivity was lost.

3.4.2. Food diary

Following consent to participate in the study, the mother was also asked to record details of their infant's dietary intake for the first year of life. Instructions on how to complete the food diaries was given at the recruitment appointment (see Appendix C). They were provided with a 4 week 7-day food diary (see Appendix D). There was a morning, afternoon, evening and night section for each day. They returned this 4 week diary (when completed) in a pre-paid envelope to the PIFA study office. Before the end of each 4 week period, the subject was sent a new food diary. The mother was asked to simply write down anything the infant ate or drank e.g. breast milk, breast milk & formula top-up, potato & carrot puree etc. If they used formula they

were asked to note down the brand used and if/when they switched to another formula. All dietary intake data collected was anonymised.

Epidemiological studies require techniques of dietary assessment to be rapid and not labour intensive, for both the subject and the data analyst (Margetts and Nelson, 1997). Using the method of a 7-day 4-week food diary was thought to be the best method for collecting the required data. This method does not rely on recall, which is a weakness of many methods assessing dietary intake. Recording the infant's diet prospectively provides more accurate, reliable data but by not asking for quantitative data for 3 of the 4 weeks, the work required to complete the diaries was kept to a minimum.

To avoid information bias, subjects were not be informed of current DoH infant feeding recommendations by any study team member. The study team did not deliberately try to influence behaviour. Mothers were left to their own devises to feed their child as they saw fit. They were asked to record exactly what their child had consumed during their first year.

3.4.3. Baseline questionnaire (part of 30 minute recruitment appointment)

Once details of how to complete the food diary was given, trained personnel using direct data entry with standardised questionnaires conducted a face-to-face interview. Questionnaire 2 asked about baseline characteristics (see Appendix E). Section A is about the new family, Section B- the delivery, Section C- about the pregnancy, Section D- sociodemographics. For this MSc study, only section D and the questions about smoking in section C were of concern. Questionnaire 3, 4 and 5 established the allergy history of the mother, father and any siblings. This data was not used for this study.

3.5. Confounding variables

There are a number of confounding variables which may influence adherence to the DoH recommendations to exclusively breastfeed for the first 6 months of life. Some have been controlled for by the inclusion and exclusion criteria i.e. premature birth. Questionnaire 2 used in the initial interview acknowledges other variables such as gender of baby, maternal smoking, maternal and paternal age, and level of education.

3.6. Setting and facilities/equipment

The research site of the study was within the Winchester and Eastleigh NHS Trust. The questionnaires and food diaries used in the study had already been completed and stored by the PIFA study team. Food diaries were anonymous and were stored in a lockable filing cabinet within the study office. Other anonymised data were stored in separate filling cabinets in the same office. Food diaries were removed and relevant information recorded from them. Relevant information was also recorded from Questionnaire 2 (Socio-demographic data). A desk and computer was required within Southampton University PIFA study team office. This is where data analysis work was undertaken.

3.7. Sample size and justification

Estimation of an appropriate sample size was a vital requirement of this study, so the results found could be extrapolated confidently to the broader population of which the study population is a part (Margetts and Nelson, 1997). Sample size calculations are almost mandatory in research protocols to obtain ethical approval (Campbell, Julious, & Altman,1995). This study looked at exclusive breastfeeding rates at six months comparing the upper and lower education levels as the outcome measure. The sample size for two independent groups with a binary outcome therefore, at the

5% significance level, with a power of 80%, was calculated as follows (using data from the 2005 Infant Food Survey [Bolling et al, 2007] from 4 months):

- Identify the success proportion in each group, i.e. p_A (left school before 16 - breastfeeding at 4 months - 8%) and p_b (left school after 16 - breastfeeding at 4 months - 23%). (Bolling et al, 2007)
- Calculate the average of p_A and p_b (p(ave) = 15.5)
- Calculate the standardised effect size (6), a function of the above two factors, 6 = (p_A - p_b /square root of p(ave) x (100-p(ave)) therefore 6=0.414 (to 3 d.p).
- Power, z (1-β), is the chance of obtaining a significant result incorrectly, or the risk of a Type II error we will accept, in this case, β=80%.
- The probability of observing a difference from the null hypothesis is known as the p-value, or the level of significance (z (1-α/2)□); the risk of a Type I error (α= 1-erf [n/√2]), accepted in this study was 5% (α=0.05).

After inputting this data into GPower3 (see appendix F), a sample size of 93 per group was calculated, a minimum of 186 subjects would be required to deliver statistically meaningful results. 1170 women provided data, mothers who returned food diaries whether it being 1 or 6 diaries were included in this study, whiched totalled 905.

3.8. Method of statistical analysis

Defined dependent and independent variables for testing the primary hypothesis

- Dependent variable: Breastfeeding duration. Breastfeeding exclusivity.
- Independent Variable: Maternal education.

Exclusivity was based on the WHO defination as the intake of breast milk only without any other drink or food for the first six months of the infant's age (WHO, 2008). This was calculated using information about breastfeeding termination and timing of introduction of liquids, semi-solid and solid foods. Duration was calculated using information about breastfeeding termination.

Non-parametric tests were applied to the data as the data calculated was not normally described via SPSS analysis. Normality was tested using the Kolmogorov-Smirnov normality test due to the sample size being greater than 100 (Coakes and Steed, 2007).

Kruskal-Wallis was used to determine whether maternal education lowers average breastfeeding duration and average exclusive duration. The women were divided, initially, into groups according to age (<20, 21-25, 26-30, 31-35 and >36) and according to the education attainment (finished full time education before 18 , completed or continued further education at 18). Differences between the groups were tested using the Mann-Whitney U. Statistical differences were significant with p-values of 0.05, and highly significant with p-values of 0.001. The tests produced the statistics required to reject or accept the hypothesis.

Breastfeeding duration and exclusivity is subjected to confounding factors. Many of the factors of interest have been found to influence duration and exclusivity to some extent. A couple have been controlled for by the inclusion and exclusion criteria i.e. premature birth.

3.8.1 Confounding variables

- Gender of the baby
- Maternal smoking

- Area setting (urban or rural)
- Parity

Logistic Regression analysis was used to determine the level of effect from combined independent variables on the dependent variable. This would adjust for the confounding effects to be able to assess the true level of effect. Between breastfeeding duration and exclusivity(dependent) and maternal education (independent) with other independent variables e.g. gender of the baby, maternal smoking, parity and area.

A Kaplan Meier time course anaylsis was applied to the data. The analysis started from birth up until six months of age, and recorded exactly when breastfeeding ceased. The analysis was performed to compare the two low and high socio-economic groups on breastfeeding duration and exclusive breastfeeding duration.

Descriptive statistics provided mean measurements with standard deviations for the range of variables and how exclusivity was lost. Statistical Package for the Social Sciences (SPSS) was used for all statistical analysis (Version 17, SPSS, Chicago, *Ill.*, USA).

Chapter 4. Results

4.1. Social and demographic characteristics

Table 4.1 provides descriptive statistics of the study sample. The cohort consisted of a total of 905 women. The mean age of the mothers was 31.86 years and 47.72% of the mothers were having their first child. The mother's education attainment is split into two groups, up to 18 years (n=78) and above 18 years (n=825), 91.16% of the mothers in the cohort attained education above 18 years. The sample largely came from rural areas (77.97%).

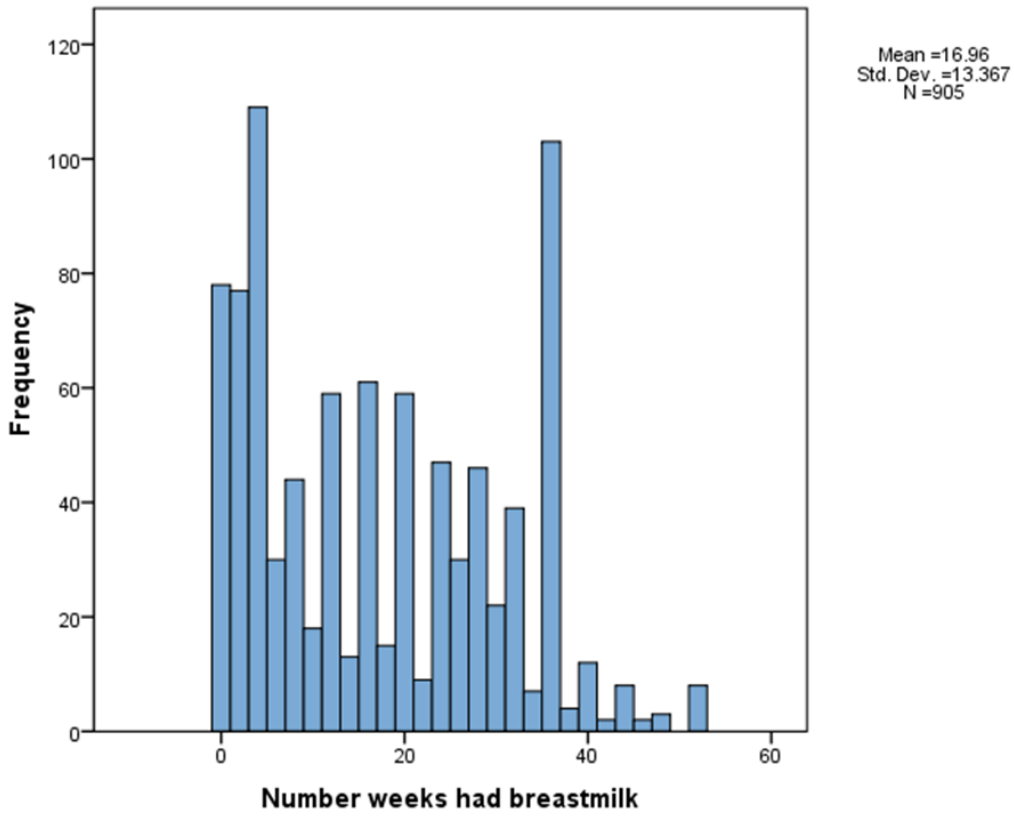


Figure 4.1 Number of weeks mothers breastfed their child.

4.2. Number of weeks breastfed

The median number of weeks the women breastfed for was 16 (mean = 16.96, mode 36), ranging from 0 to 52 weeks. The sample had a large std dev at 13.37, meaning

Table 4.1 Social and demographic characteristics of population sample.

	n	%
Age of mother		
<20	8	0.89
21-25	68	7.5
26-30	221	24.42
31-35	372	41.11
>36	236	26.08
Total	905	100
Parity		
First Child	432	47.72
Later Child	468	51.7
Valid Total	900	99.45
Missing	5	0.6
Total	905	100
Sex of baby		
Boy	467	51.6
Girl	437	48.29
Valid Total	904	99.89
Missing	1	0.11
Total	905	100
Does the mother smoke		
Yes	40	4.42
No, ex-smoker	321	35.47
No, never smoked	544	60.11
Total	905	100
Mothers education		
Up to 18 years	78	8.62
Above 18 years	825	91.16
Valid Total	903	99.78
Missing	2	0.22
Total	905	100
Housing Area		
Urban	200	22.1
Rural	705	77.9
Total	905	100
Child ever breastfed		
Yes	827	91.38
No	78	8.62
Total	905	100

that the data is spread out over a large range of values. So most of the sample breastfed for 3.6 - 30.3 weeks. The mode tells us that within the sample, 36 weeks was the duration most popular to breastfeed for (97 women). Overall, 91.4% of the women initiated breastfeeding, at 1 month 75.2% were still breastfeeding. By 3 months just over half, 57.6% were breastfeeding and at 6 months this falls to 35.5%.

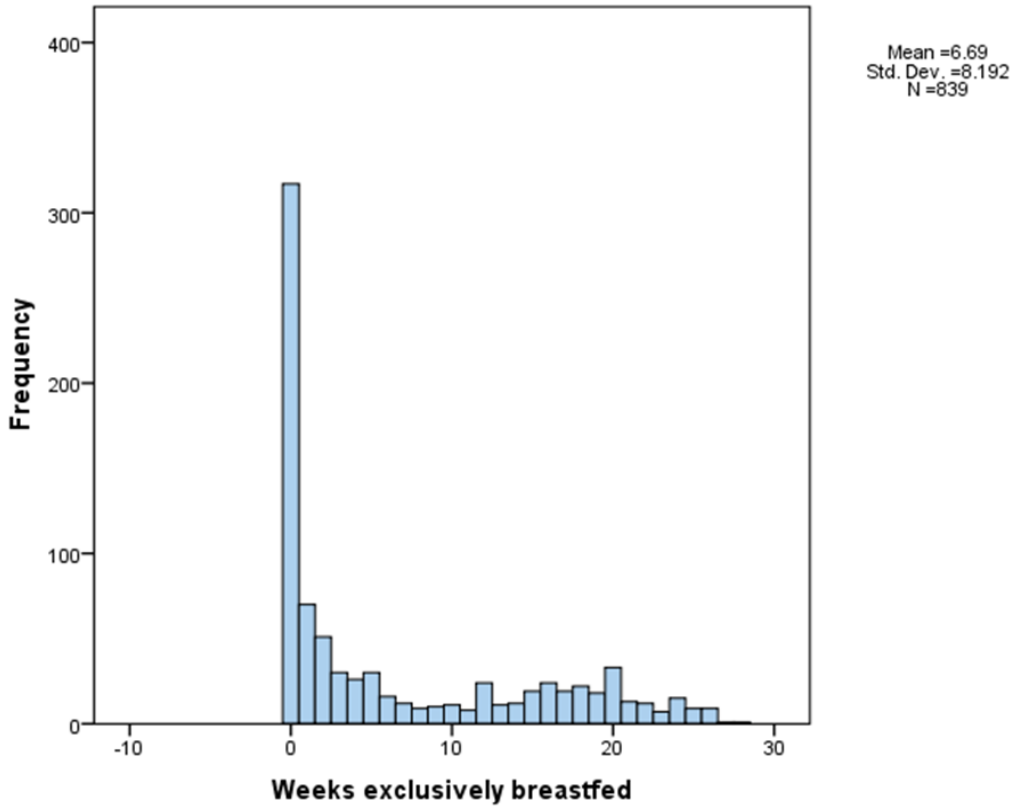


Figure 4.2 Number of weeks mothers exclusively breastfed their child.

4.3. Number of weeks exclusively breastfed

The median number of weeks the mothers exclusively breastfeed for was 2 (mean =6.69, mode= 0) ranging from 0 to 28 weeks. The sample had a std dev of 8.19. Meaning that most of the sample exclusively breastfed for 0 - 14.882 weeks. The mode number of weeks was zero, meaning that in this sample a high proportion of

women did not attempt to exclusively breastfeed. 44.2% of women from the sample exclusively breastfed for 1 month. At 4 months this falls to 29.7% and by 6 months only 1.3% of mothers were exclusively breastfeeding.

Table 4.2 Breastfeeding duration and exclusivity by social and demographic factors

	Mean duration of Breastfeeding (weeks)	Mean duration of Exclusive Breastfeeding (weeks)
Age of mother		
<20	9.88	2.43
21-25	9.62	3.18
26-30	15.57	6.15
31-35	17.92	7.57
>36	19.1	7
Parity		
First Child	17.48	7.39
Later Child	17.27	6.11
Sex of baby		
Boy	9.62	3.62
Girl	9.14	3.23
Does the mother smoke		
Yes	4.33	1.14
No, ex-smoker	16.35	6.39
No, never smoked	18.88	7.31
Mothers education		
Up to 18 years	14.47	7.48
Above 18 years	21.78	10.14
Housing Area		
Urban	4.47	1.33
Rural	11.75	4.44

4.4. Breastfeeding duration by social and demographic factors

The mean duration of breastfeeding shown in figure 4.3 and table 4.2 shows that as the age of the mother gets higher, so does the mean duration of breastfeeding ($H_{(2)}$ = 39.507, p<0.001). A longer breastfeeding duration is also seen if the child is the mother's first ($H_{(2)}$ = 0.037, p=0.84). Girls from the sample were breastfed for slightly less time than the boys ($H_{(2)}$ = 0.001, p=0.971). Women who smoke breastfed their babies for a shorter period of time compared to ex and never smokers, and women

who had never smoked breastfeed their child for the longest period ($H_{(2)} = 47.952$, $p<0.001$). Mothers who went onto further education after 18 years of age breastfed for longer than the mothers who finished education at 18 years and younger ($H_{(2)} = 10.303$, $p< 0.001$). Women who lived in a rural setting also tended to breastfeed for longer than women who lived in an urban area ($H_{(2)}= 8.124$, $p=0.004$).

A post hoc test (Mann Whitney U) was then used to test for differences between the separate age groups. Figure 4.3 shows the mean duration of breastfeeding for each age group and the significant differences between the ages.

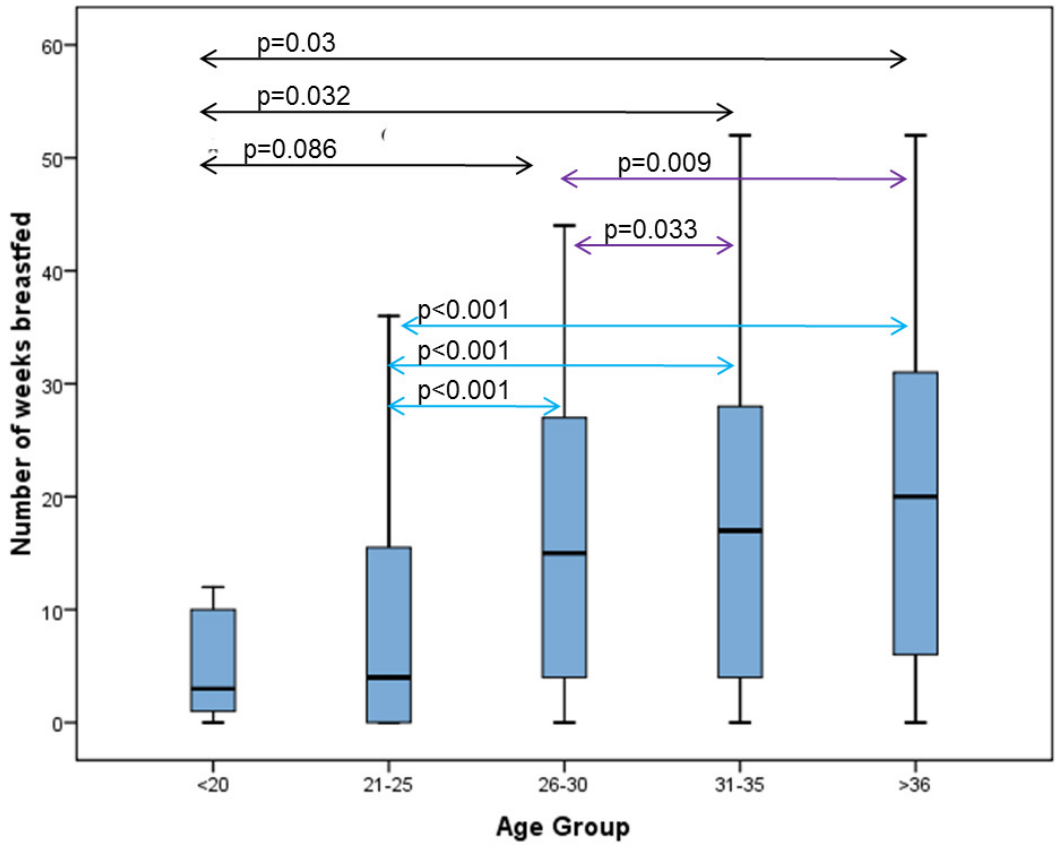


Figure 4.3 Mean duration of breastfeeding by maternal age.

The Mann Whitney U showed significant differences between all the smoking groups, and is shown in figure 4.4.

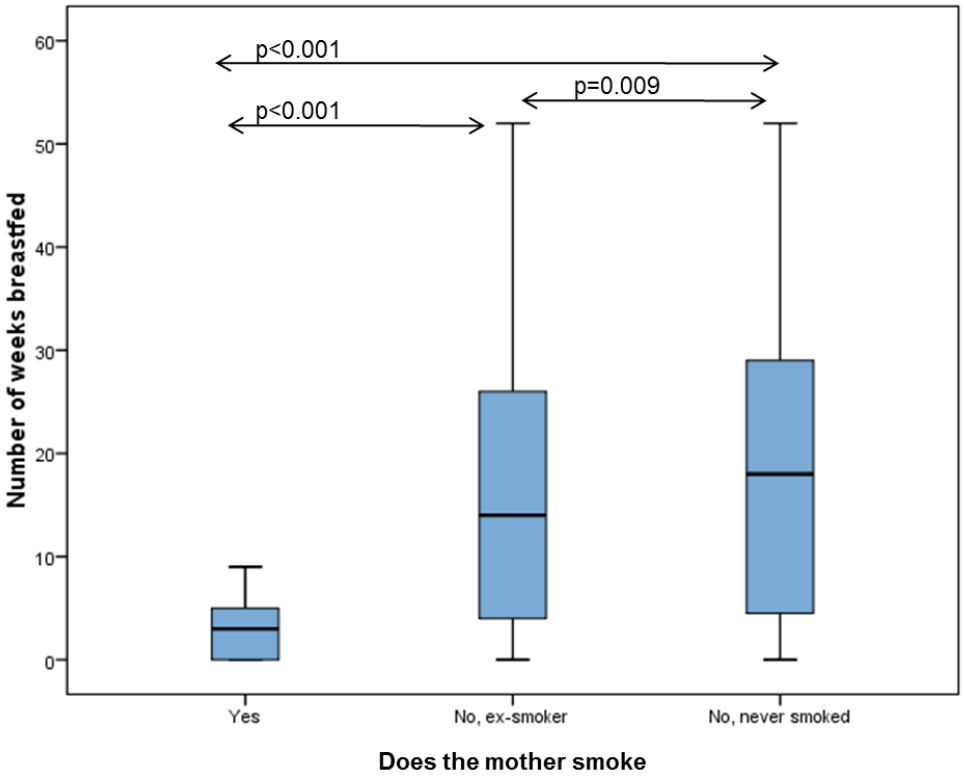


Figure 4.4 Mean duration of breastfeeding by maternal smoking status.

4.5. Exclusive breastfeeding duration by social and demographic factors

The mean duration of exclusive breastfeeding shown in table 4.2 shows that as the age of the mother gets higher, so does the mean duration of exclusive breastfeeding ($H_{(2)}$ = 12.830, p=0.012). A longer exclusive breastfeeding duration is also seen if the child is the mother's first ($H_{(2)}$ = 5.874, p= 0.015). Girls from the sample were exclusively breastfed for slightly less time than the boys ($H_{(2)}$ = 0.021, p=0.647). Women who smoke exclusively breastfed their babies for a shorter period of time compared to ex and never smokers, and women who had never smoked exclusively breastfeed their child for the longest period ($H_{(2)}$ = 21.850, p<0.001). Mothers who went onto further education after 18 years of age exclusively breastfed for longer than the mothers who finished education at 18 years and younger ($H_{(2)}$ =4.213, p=0.04). Women who lived in a rural setting also tended to exclusively breastfeed for longer than women who lived in an urban area ($H_{(2)}$ = 1.502, p=0.220).

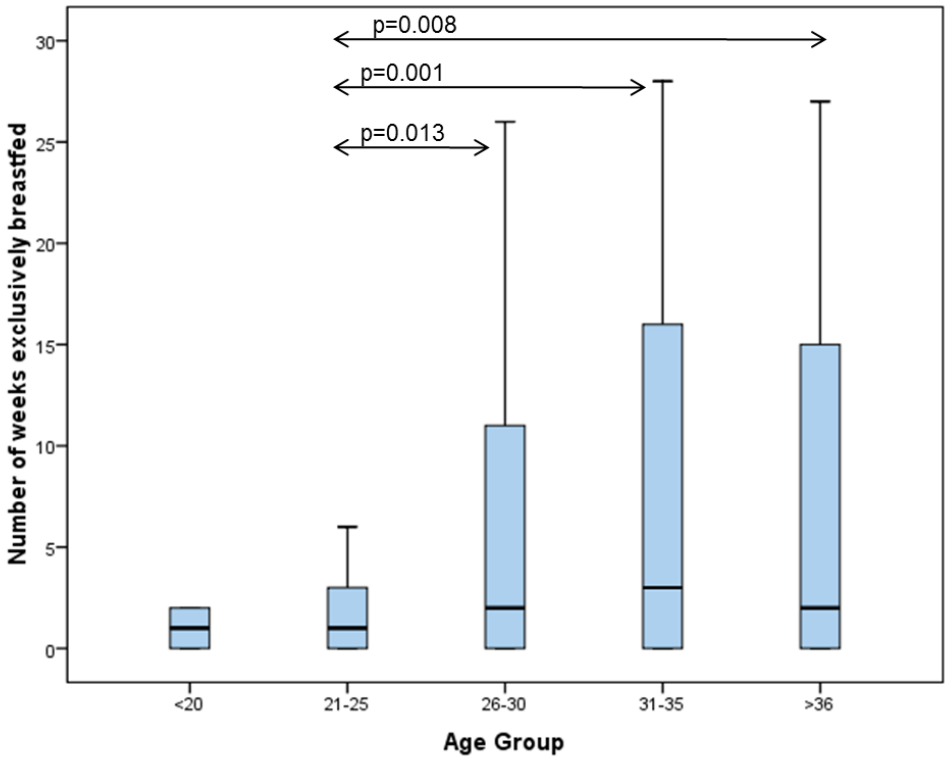


Figure 4.5 Mean duration of exclusive breastfeeding by maternal age.

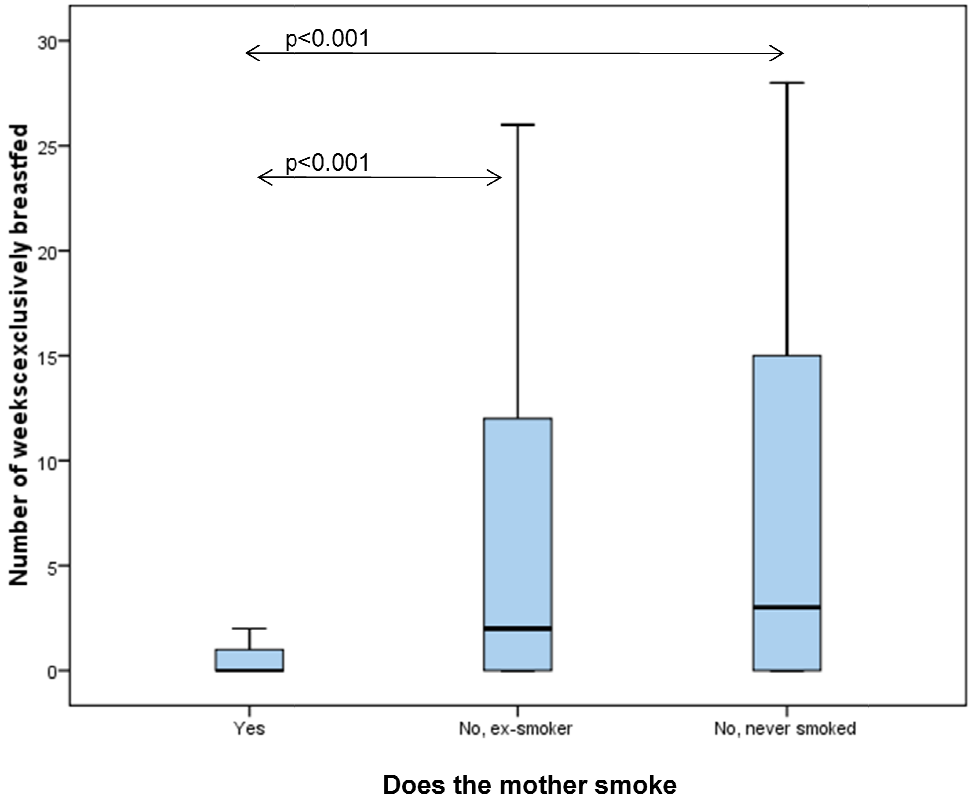


Figure 4.6 Mean duration of exclusive breastfeeding by maternal smoking status.

The Mann Whitney U was then used to test for differences between the separate age groups. Figure 4.5 shows the mean duration of exclusive breastfeeding and the significant differences between the age groups. The Mann Whitney U showed significant differences in the duration of exclusive breastfeeding between the smoking groups. Figure 4.6 shows the mean duration of exclusive breastfeeding and significant differences between the groups.

4.6. Associations between initiation and breastfeeding duration

Table 4.3 shows odds ratios (OR) and 95% confidence intervals (CI) estimated using logistic regression analysis for the effect of maternal education, maternal age, parity, maternal smoking and housing area on the initiation and duration of breastfeeding. The figures revealed that women with a higher education attainment were over three times more likely to initiate breastfeeding ($p<0.001$) than women with a lower educational attainment. Initiation was also associated with maternal age and parity, older mothers were 1.08 times more likely to initiate compared to the younger mothers ($p<0.05$) and mothers who were having their first child were 1.9 times more likely to initiate breastfeeding ($p<0.05$) compared to mothers who were having a subsequent child.

Table 4.3 Odds ratio (OR) and 95% confidence interval (CI) for effect of socio-economic and demographic factors on initiation and breastfeeding duration.

	Initiated breastfeeding		Breastfeeding at 2 months		Breastfeeding at 6 months	
	OR ǂ	95% CI	OR ǂ	95% CI	OR ǂ	95% CI
Maternal Education	3.75***	2.03-6.93	2.71***	1.59-4.62	1.96*	1.05-3.67
Maternal age	1.08*	1.03-1.14	1.07***	1.03-1.10	1.04*	1.01-1.08
Sex of child	1.56	0.95-2.56	1.04	0.77-1.42	0.88	0.65-1.19
Parity	1.9*	1.14-3.16	1.07	0.78-1.47	0.91	0.66-1.24
Area	1.33	0.77-2.29	1.24	0.85-1.80	1.16	0.79-1.70
Maternal smoking	1.26	0.84-1.88	1.53*	1.16-2.00	1.59*	1.19-2.12

ǂ Logistic regression including all six variables in model predictors.

* significant at $p \leq 0.05$

*** significant at $p \leq 0.001$

Duration was compared at two time points, at two months and at the crucial six months. Maternal education was positively associated with breastfeeding at two months, mothers with the higher education attainment were 2.71 times more likely to be breastfeeding at two months ($p<0.001$) than mothers with a lower education attainment. Older mothers were 1.07 times more likely to be breastfeeding at two months ($p<0.001$) than the younger mothers and mothers who had never smoked had a better chance to be still breastfeeding at two months ($p<0.05$) compared to the mothers who were ex-smokers and smokers. Breastfeeding at six months was associated with the same three factors as the two month time point, the socio-economic variable of maternal education and demographic characteristics, maternal age and smoking status. Mothers who had a higher education were 1.96 times more likely to be breastfeeding at six months ($p<0.05$) compared to the mothers with the lower education attainment. Older mothers were 1.04 times more likely to be still breastfeeding at six months ($p<0.05$) than the younger mothers. Mothers who had never smoked were 1.59 times more likely to be breastfeeding at six months ($p<0.05$) compared to ex-smokers and smokers.

4.7. Associations between initiation and exclusive breastfeeding duration

Table 4.4 shows odds ratios (OR) and 95% confidence intervals (CI) estimated using logistic regression analysis for the effect of maternal education, maternal age, parity, maternal smoking and housing area on exclusive breastfeeding duration. The figures reveal that women with a higher education attainment were over three times more likely to exclusively breastfeed for two months ($p<0.05$) compared to mothers who have a lower education attainment.

Table 4.4 Odds ratio (OR) and 95% confidence interval (CI) for effect of socio-economic and demographic factors on exclusive breastfeeding duration.

	Exclusive breastfeeding at 2 months		Exclusive breastfeeding at 6 months	
	OR ǂ	**95% CI**	**OR ǂ**	**95% CI**
Maternal Education	3.05*	1.51-6.16	1.05	-
Maternal age	1.02	0.99-1.06	0.99	0.86-1.15
Sex of child	1.08	0.81-1.45	2.06	0.59-7.16
Parity	0.77	0.57-1.05	0.35	0.09-1.40
Area	1.32	0.91-1.92	2.36	0.30-18.83
Maternal smoking	1.26	0.96-1.66	5.28	0.68-40.72

ǂ Logistic regression including all six variables in model predictors.

* significant at $p \leq 0.05$

*** significant at $p \leq 0.001$

4.8. Education attainment as a factor of breastfeeding survival

Logistic regression OR showed that maternal education was the strongest predictor of initiation, breastfeeding duration and exclusive breastfeeding duration even when other variables were added to the model. A Kaplan-Meier analysis was applied as a secondary analyses to obtain the survival chance for breastfeeding and exclusive breastfeeding at six months only looking at the strongest predictor; maternal education.

Table 4.5 Kaplan-Meier mean duration of breastfeeding (using six month data).

		95% CI	
Means for survival times	**Weeks**	**Lower**	**Upper**
Low education	7.59	5.33	9.85
High education	11.46	10.65	12.28
Overall	11.13	10.35	11.91

Table 4.5 shows the Kaplan-Meier mean duration of breastfeeding. The mean has decreased in both groups. Women with a lower educational attainment has gone from an average of 14.47 weeks to an average of 7.59 weeks, this is due to only six month data being used, women who breastfed for longer than 26 weeks have not been included in the analysis so bring the average down. The mean number of

weeks dramatically decreased for women who completed a higher education, to 11.46 weeks from 21.78 weeks. The larger decrease in the high education group illustrates that a larger percentage of the mothers in the high education group breastfed for over 26 weeks. Causing the bigger decrease in the means compared to the mothers in the low education group.

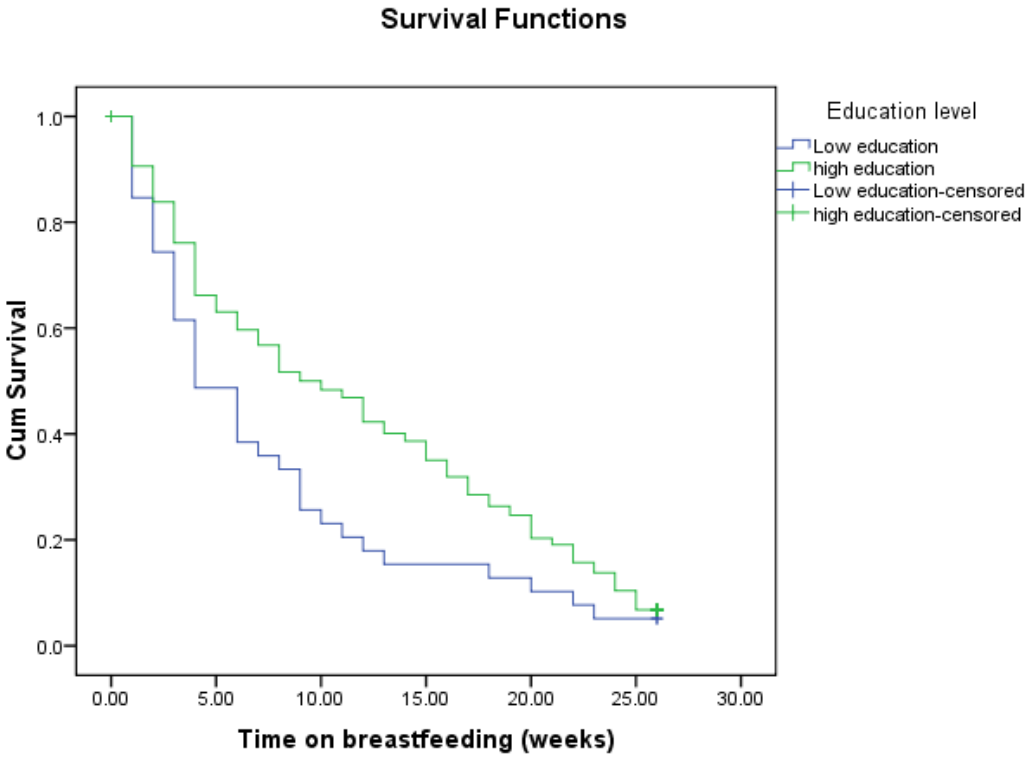


Figure 4.7 Kaplan-Meier breastfeeding cessation survival curves for breastfeeding duration for low and high educational attainment mothers.

Figure 4.7 demonstrates, that women who have a higher education survive longer when they start to breastfeed, where as women from a lower education stop breastfeeding much more quickly and this trend is seen throughout the six months (X^2 =6.73, p<0.05) as the low education group are always below the high education group. After week one 25.4% of the women from the low education group stop breastfeeding, more than double compared to the 9.4% of the women from the high education group that stop after one week. By week 4, 66.2% of the higher education mothers are still breastfeeding, but less than half (48.7%) of the mothers with a lower education attainment are still breastfeeding.

During weeks 1 to 4 the two groups follow a similar pattern of survival. During these first few weeks there is a greater risk of breastfeeding cessation as large amounts of mothers stop breastfeeding. A difference in pattern occurs at week 5 for the high education mothers as the risk of breastfeeding cessation decreases which is seen as a more gradual decline in the curve. From week 5 onwards survivals stays steady as a similar amount of women stop breastfeeding each week throughout the 26 weeks.

Women who have a lower education attainment do not see a decrease in breastfeeding cessation risk until week 6 by which time only 38.5% are still breastfeeding. Then from week 6 to week 8 the risk of breastfeeding cessation decreases and only 5.2% of the women stop breastfeeding during those three weeks. At week 9 a large amount stop breast feeding but the similar pattern from weeks 6 to 8 are seen from weeks 9 to 13 where the risk of breastfeeding cessation decreases as only a small amount of women stop breastfeeding during this time, meaning the risk of breastfeeding cessation is low. From weeks 13 to 17 breastfeeding cessation risk dramatically decreases as no women stop breastfeeding during this time. From then on a steadier period of breastfeeding cessation occurs till the 26 weeks.

4.9. Education attainment as a factor of excusive breastfeeding survival

Table 4.6 shows the Kaplan-Meier mean duration of exclusive breastfeeding (which only includes women who breastfed for 1-25 weeks). The mean duration has not changed for the women in the low education group (7.48 weeks) compared to the general mean of excusive breastfeeding which was also 7.48 weeks. This is because no women in the low education group actually breastfed for 6 months exclusively or longer. The Kaplan-Meier mean duration of exclusive breastfeeding for the high education group has slightly decreased to 10.88 weeks from 10.94 weeks (the general mean of exclusive breastfeeding duration of high educated mothers). This decrease occurred due to the analysis not including mothers from the high education

group who did manage to exclusively breastfeed till the recommended 6 months, and the mothers who exclusively breastfed for longer than the 6 months.

Table 4.6 Kaplan-Meier mean duration of exclusive breastfeeding (using six month data).

		95% CI	
Means for survival times	**Weeks**	**Lower**	**Upper**
Low education	7.48	4.97	9.99
High education	10.88	10.17	11.58
Overall	11.13	10.03	11.40

Figure 4.8 illustrates that women who have a higher education survive longer when they start to exclusively breastfeed, where as women from a lower education stop exclusive breastfeeding much more quickly and this trend is seen throughout the six months (X^2=6.74, p<0.05) as the low education group are always below the high education group. After week one 80% of the women from the low education group are still exclusively breastfeeding, compared to the 87% of the women from the high education group that are still breastfeeding after one week. It only takes 5 weeks for 50% of the lower educational attainment women to cease exclusive breastfeeding, whereas it takes double the time, 10 weeks for 50% of the women with a higher education to cease exclusive breastfeeding.

During weeks 1 to 4 the two groups follow a similar pattern of survival. During these first few weeks 33.3% of the highly educated women and 48% of the lower educated women stop exclusive breastfeeding and so there is a greater risk of exclusive breastfeeding cessation. A difference in pattern is not seen until week 5 in the high education women as the risk of exclusive breastfeeding cessation begins to decrease, which is seen as a more gradual decline in the curve. From week 5 women in the high education group steadily cease exclusive breastfeeding each week throughout the 26 weeks. With the exception seen in week 20 when 6.7% of the

mothers stop exclusively breastfeeding their child, a larger proportion compared to the weeks previously and subsequently.

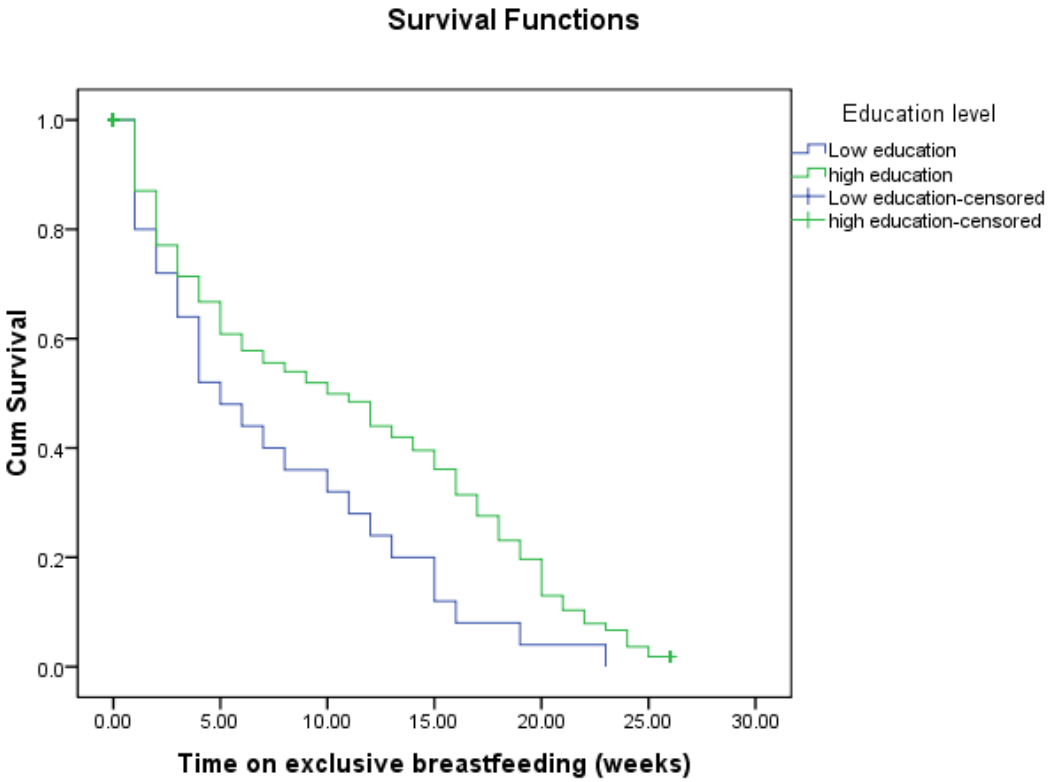


Figure 4.8 Kaplan-Meier breastfeeding cessation survival curves for exclusive breastfeeding duration for low and high educational attainment mothers.

Women who have a lower education attainment see a decrease in exclusive breastfeeding cessation in week 4, a week before the high education women. In the continuing weeks the mothers steadily cease exclusive breastfeeding, albeit at a quicker time compared to the higher education mothers. The low education curve reaches zero meaning that none of the mothers exclusively breastfed their child for six months.

4.10. How exclusive breastfeeding status was lost

Figure 4.9 shows that 56.46% of mothers who fed exclusively at birth lost their exclusive feeding status by giving their baby whey formula, while a further 2.17% lost

it by introducing other formulas or liquids (e.g. soya and casein formulas), while 41.37% lost their exclusive feeding status by first introducing solids. Of the solids baby rice and baby cereal was the most common foods introduced.

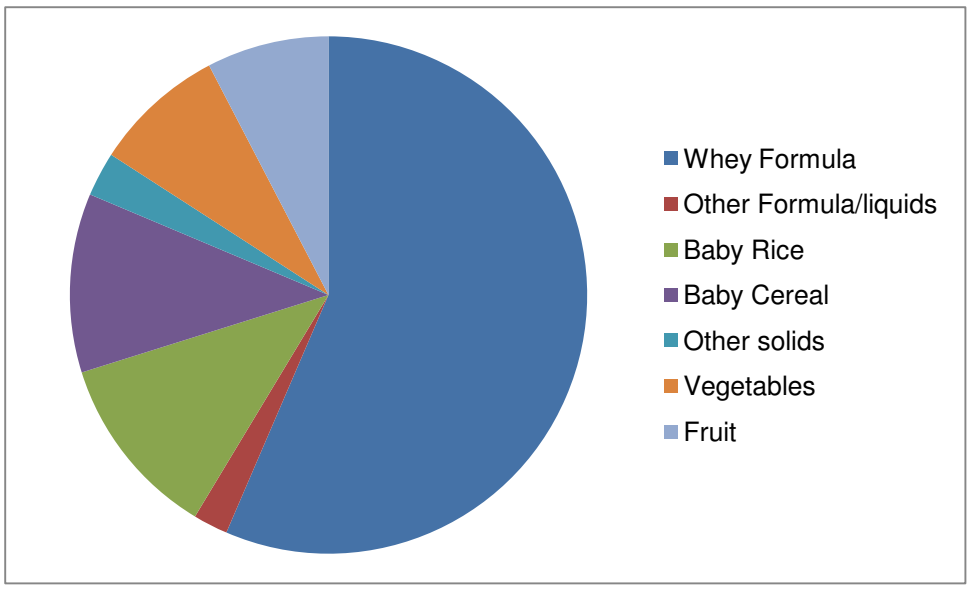


Figure 4.9. How mothers who breastfed exclusively at birth lost their exclusive feeding status.

There were clear differences between the two education groups, to how they lost their exclusive feeding status; of the low education mothers 91.43% introduced whey formula first, compared to 78.66% of mothers with a higher education who introduced the whey formula first, for mothers that lost their exclusive breastfeeding status by introducing baby rice (the most common solid); there is a similar difference, with 0.29% of the mothers in the low education group introducing baby rice first compared to 17.45% of mothers from the high education group.

The duration of exclusive breastfeeding also differs by how exclusive feeding status was lost. Mothers who fed exclusively at birth who lost their exclusive feeding status by the introduction of whey formula on average only exclusively breastfed their child for 3.93 weeks while mothers who did not introduce whey formula as the first substance after breast milk on average breastfed exclusively for 17.76 weeks ($H_{(2)}$ =

272.56, $p<0.001$). Mothers who lost their exclusive feeding status by the introduction of baby rice (solid) on average exclusively breastfed their child for 19.69 weeks while mothers who did not introduce baby rice as the first substance after breast milk on average breastfed exclusively for only 4.22 weeks ($H_{(2)} =292.25$, $p<0.001$).

Chapter 5. Discussion

Breastfeeding has clear health benefits for both mother and infant. Due to the body of evidence on the health benefits of breastfeeding, it is vital that it must be promoted as the best way of ensuring a healthy start for infants. This study aimed to assess whether maternal socio-economic status had an effect on breastfeeding and exclusive breastfeeding duration, results will hopefully disseminate, so to improve and inform future breastfeeding promotion and programmes. Principle outcomes of the study were:

- A high maternal education as a socio-economic factor was a very powerful predictor of initiation, longer breastfeeding duration and two month breastfeeding exclusivity.
- An older maternal age was associated with initiation and longer breastfeeding duration.
- Women who initiated breastfeeding were more likely to 'survive' and continue breastfeeding and exclusive breastfeeding if they had a higher education attainment.
- More than half of mothers that exclusively breastfed at birth lost exclusivity to the introduction of formula/liquids and exclusively breastfed their child for a shorter amount of time.

5.1. Strengths and limitations

The strength of this study lies in its study design and its large sample size. As a longitudinal prospective study, food diary results are not subject to recall bias or other bias due to the respondent wanting to 'give the correct answer'. The study had a wide range of other information about the infants and their families, so that it was possible to adjust for important confounders. What limits this study is the

disproportion of its demographic characteristic compared to the general population. It could be argued that the strong relationship found between maternal education and breastfeeding could be subject to bias due to the high proportion of older and more educated mothers in the study.

5.2. Social demographic characteristics

Sample size calculations estimated that a minimum number of subjects needed would be 186 so results produced from the study would be statistically meaningful and predictable of UK women. 905 women took part in this study and returned their food diaries, nearly 5 times the numbers needed. Therefore, the large study's sample size meant that the results reported in infant feeding practices could be found significant, which they were and that the results seen and described in this report had not just happened by chance.

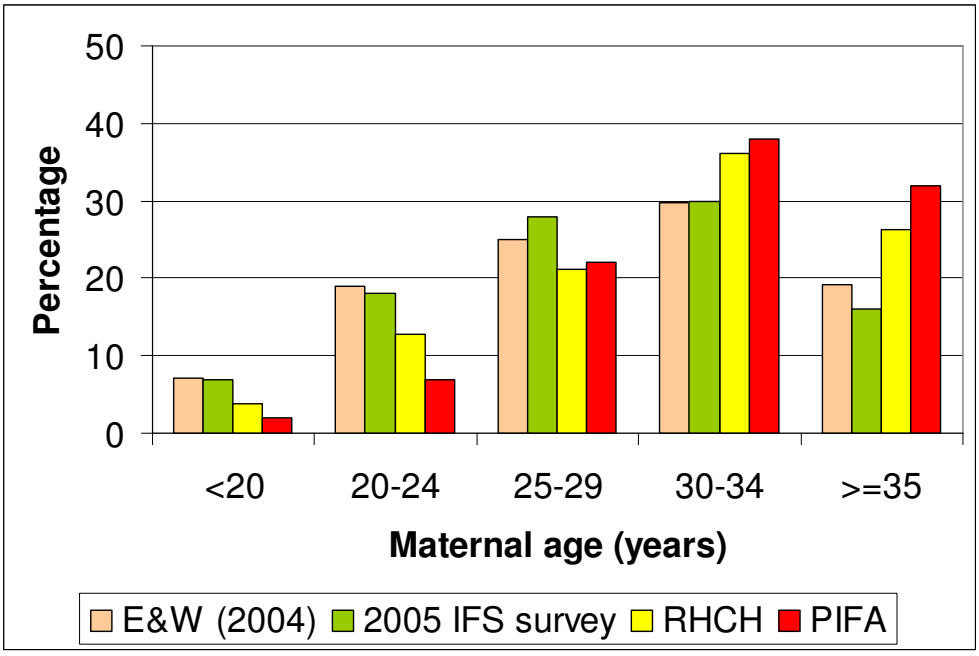


Figure 5.1: Comparison between maternal age in UK birth cohort and other comparative populations.

The age of the women ranged from 16 to 47, 0.89% of the women were 20 years and younger, 7.5% were 21-25, 24.42% were 26-30, 41.11% were 31-35 and the 36 years and over consisted of 26.08% of the sample. This spread and proportion of age is not a typical representation of the UK birthing population. Figure 5.1[1] shows the percentage of mothers in each age group at enrolment into the UK birth cohort (PIFA), in comparison with England and Wales population, 2004 (E+W), the 2005 Infant Feeding Survey (Bolling et al, 2007) and 2007 data of women delivering at Royal Hampshire Country Hospital, Winchester (RHCH). The data reveals that the under 20 and the 20-24 age groups are disproportionally less representative of a typical birthing population, of not only England and Wales but of Winchester, where the mothers were recruited from. While the 35 and over age group are actually over represented in this study. The age groups 25-29 and 30-34 are slightly higher in this study compared to the general birthing population but not as disproportionally as the other ages in this study. The low amount of young women in this study could be explained by the argument that younger study participants generally have lower response rates. Figure 5.2[2] shows a bar chart, the bars represent the percentage of mothers returning food diaries for different time periods by maternal age. The older mothers were more likely to complete the diaries for longer and so a high proportion of older women were in the sample compared to the younger mothers who were less likely to complete the diaries for longer and so where not correctly proportionally represented.

The average age for giving birth in the UK is 29.4 years (Office for National Statistics, 2009); in this study the average age of the mother was 31.86 years, only a slight increase on the national average. Hawkins, Griffiths, Dezateux and Law (2007) foundthat the mean maternal age at birth for the Millennium Cohort Study was 30

[1] Provided by Kate Grimshaw
[2] Provided by Kate Grimshaw

years, implicating that this study's mean maternal age is very typical for breastfeeding literature.

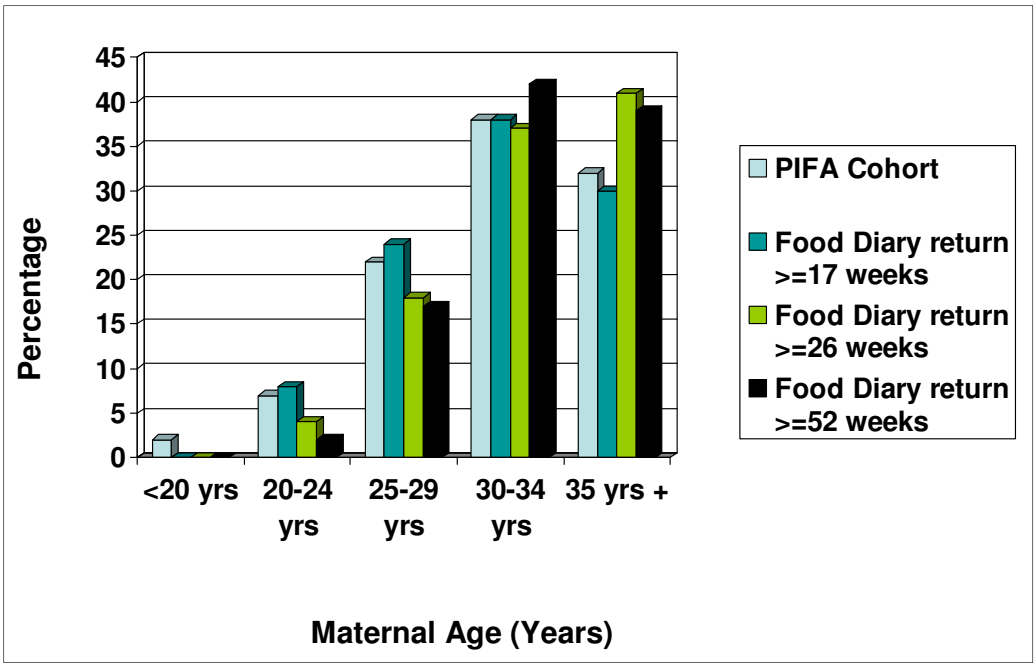
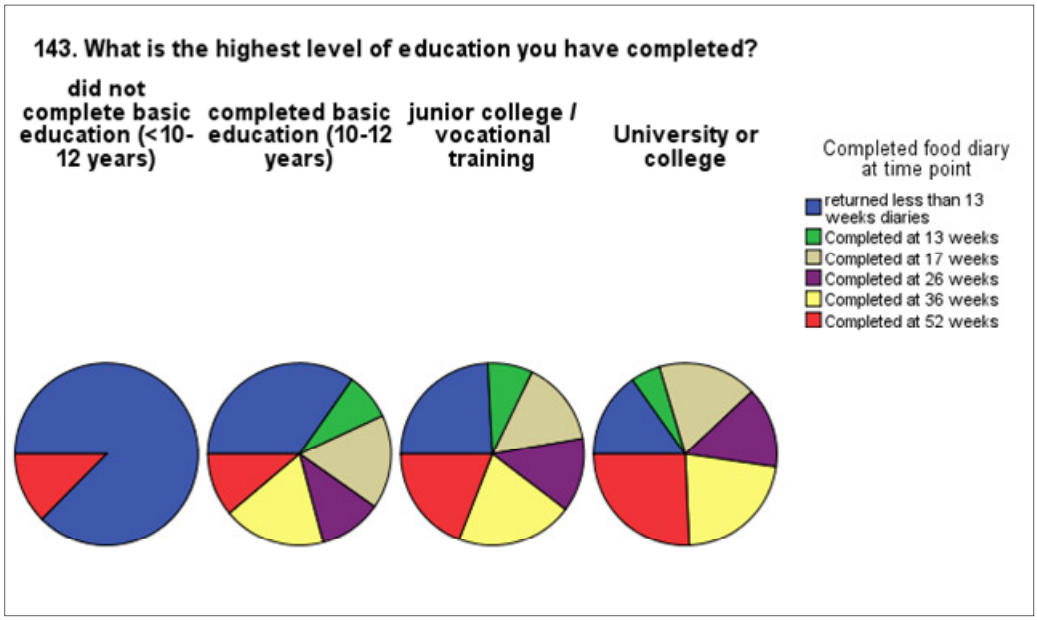


Figure 5.2 Food Diary return and maternal age.

According to 2001 figures from the Department for Education and Skills the overall proportion of women going into higher education is 46.7%. In The Infant feeding Survey (2007) 38% of the mothers had completed full time education at 19 or continued education, these women were categorised and represented the high education group in the survey. The mothers in this sample do disproportionally represent this part of the UK population as 91.16% of the women continued education after the age of 18. The Gpower sample size calculations stated that 93 women were needed in a group. When comparing maternal education level there were only 78 women in the low education group. The minimal numbers in the low education group may have strengthened the significant results seen between the relationship of education and breastfeeding duration and caused a heightened relationship. Selective participation could explain the results; none-responders would

have been more often of a low education attainment. The low representation of the lower educated mothers in this study partially could be explained due to low response rates and diary return rates in this group of mothers. Figure 5.3[3] shows pie charts that represent the relative proportions of mothers completing food diaries for different lengths of time by their level of education. The figure shows that in general,



the lower the level of maternal education, the less time the diaries were completed for, and so have a lower diary return rate compared to the mothers with a higher level of education.

Figure 5.3: Relative proportions of mothers completing food diaries for different lengths of time by their level of education.

The proportion of mothers with a higher education is rising in the UK. In just the 5 years between the 2000 and 2005 Infant Feeding Surveys a 10% rise in more educated mothers was seen and it is predicted that these changes between 2000 and 2005 continue a longer-term trend towards a sample of mothers becoming more educated, which this study sample represents.

[3] Provided by Kate Grimshaw

'Focus on People and Migration' a UK government review (2005), reported that 80% of the population live in an urban area, 22.1% of this sample population lived in an urban area and so are underrepresented in this study.

5.3. Breastfeeding duration

A total of 91.38% of mothers initiated breastfeeding; by 1 month 75.2% of the mothers were breastfeeding their child. By 3 months this drops to 57.6% of the sample and by 6 months a further decline to 35.5%. These results show a similar pattern of decline seen in other UK studies. The government funded Infant Feeding Survey (Bolling et al, 2007) of 2005 found that 78% of babies were ever breastfed and by 6 months 26% of babies were still being breastfed. Kelly and Watt (2004) used results from The Millennium Cohort study (a longitudinal survey of babies across the UK), and found similar results as the Infant Feeding Survey, with 71% of mothers initiating breastfeeding. While a study in Gateshead UK, found that only 49% of mothers initiated breastfeeding and declined to 25% at 6 weeks (Wright, Parkinson, & Scott, 2006). The papers authors do state that this is an unusually low initiation rate for a large study (n=923) but may reflect a particularly urban setting, this could help explain the higher initiation and duration rates seen in this study as 76.2% of the sampled women lived in a rural area. The initiation rate found in this research however is slightly higher than the rates reported in the other studies. The differences between the studies might either be attributed to variations in study design, sample selection and variable definitions.

Breastfeeding initiation and duration trends from this study and the UK do differ compared to other developed countries. A Swedish study from 2007 found that a staggering 82% of women were still breastfeeding at 4 months and at 6 months an impressive 69% (double the rate seen in this study) of mothers were breastfeeding their child (Flacking, Nyqvist & Ewald, 2007). The United States, National Immunization Survey (Centers for Disease Control and Prevention, 2007); reported

75% of infants born in 2007 were initially breastfed. By 6 months 43% of mothers were still breastfeeding their child.

5.4. Exclusive breastfeeding duration

The exclusive breastfeeding rates for this study showed that 44.2% of the mothers exclusively breastfed for 1 month, 29.7% for 3 months and by 6 months the recommended period for exclusive breastfeeding by the Department of Health, only 1.3% of the sampled mothers were still feeding their infant exclusively on breast milk. These results are nearly exact as the 2005 Infant Feeding Survey (Bolling et al, 2007) who reported less than 1% of mothers were exclusively breastfeeding at 6 months. The millennium Cohort (Kelly and Watt, 2004) found that 0.3% of the mothers sampled exclusively breastfed their child. The dramatic decrease seen in this study and the UK surveys between exclusive breastfeeding at 1 month to 6 months among women seems to be a common trend in developing countries. A Canadian study which examined breastfeeding exclusivity (Al Sahab, Lanes, Feldman &Tamim, 2010) reported an exclusive breastfeeding rate of 63.3% at 1 month to 13.8% at 6 months. In the United States, the prevalence of exclusive breastfeeding at 6 months was 13% (Centers for Disease Control and Prevention, 2007), whereas it was 10.1% in Sweden (Brekke, Ludvigsson, van Odijk, & Ludvigsson, 2005) and 7% in Norway (Lande, Andersen, Baerug, Trygg, Lund-Larsen, Veierød & Bjørneboe, 2003).

These results show that in the UK breastfeeding rates may have risen. This could be due to the introduction of government funded projects that aim to increase the prevalence of breastfeeding. The studies' exclusive breastfeeding rates have not improved as breastfeeding prevalence has. Revealing that promotion of exclusive breastfeeding is lagging behind. A review of breastfeeding rational, prevalence,

duration and trends in European Union and EFTA countries (2001) reported that data collected in Sweden have a different definition for exclusive breastfeeding to that used by WHO and in this study. The Swedish authorities say that small portions of other foods given to babies to taste, can be included within the definition of exclusive breastfeeding (The National Board of Health and Welfare,1999) The difference in definition could suggest that Swedish data on exclusive breastfeeding could be regarded as being artificially high.

5.5. Breastfeeding duration and exclusivity by social and demographic factors

5.5.1. Maternal age

The duration of breastfeeding and exclusive breastfeeding means were looked at by different social and demographic factors. The results showed that mothers aged 20 and under, and mothers aged 21-25 breastfed for the least amount of time, only 9.88 and 9.62 weeks respectively. The fact that mothers aged 21-25 breastfed for a slightly shorter period was an unexpected result, but the difference was very small with just 0.26 weeks between the two age groups plus the difference was not significant ($p=0.952$). A continuous rise in breastfeeding duration as maternal age got older would have been seen if the women were grouped as ≤20-25 as the lowest age group. Larger age group categories have been seen in previous literature, which result in larger differences between the breastfeeding duration means. Skafida (2008) researched breastfeeding initiation in Scotland and grouped the women <20, and then 20-29 years and continued the 10 year intervals. However even with this ubexpected result logistic regression proved that maternal age is a significant factor when predicting whether or not a mother would initiate breastfeeding and how long she would breastfeed for. Older mothers were 1.08 times more likely to initiate breastfeeding ($p<0.05$, 95% CI 1.03-1.14), 1.07 times more likely to still be breastfeeding at two months ($p<0.001$, 95% CI 1.03-1.10) and 1.04 times more likely to still be breastfeeding at six months ($p<0.05$, 95% CI 1.01-1.08).

The relationship between maternal age and breastfeeding have been reported in previous studies. Hamlyn, Brooker, Oleinikova and Wands (2002) write that generally in infant feeding, mothers most likely to initiate breastfeeding are aged 30 and over. The association of maternal age being 30 and over to increase the likelihood of breastfeeding could explain why a rise in breastfeeding duration was not seen between the ≤ 20 years to the 21-25 years that actually mothers at these ages act similarly in their breastfeeding duration. Research in California showed that younger women were more likely to never breastfeed (Heck, Braveman, Cubibin, Chavez & Kiely, 2006), and breastfeeding take-up was more common among older mothers than mothers aged 20-29 years in Scotland (Skafida, 2008).

Internationally, maternal age has been repeatedly associated with initiation and duration of breastfeeding. Older women (older than 25) are more likely to initiate (Barnes, Stein, Smith, & Pollock, 1997; Ford et al., 1994; Nolan & Goel, 1995) and continue breastfeeding (Pande et al., 1997; Piper & Parks, 1996; Savage, Reilly, Edwards, & Durnin, 1998) than are younger women. Vogel, Hutchinson and Mitchell (1999) studied 350 New Zealand women and reported that younger women were at a greater risk for shorter breastfeeding duration (RR=2.33, 95% CI 1.33-4.05). Similarly, results from two United Sates national surveys that included 900,000 women, indicated that younger women were significantly less likely to breastfeed than older women (Ryan, 1997).

The mean duration of exclusive breastfeeding increased with maternal age. With the exception of the over 36 category, which saw a slight decrease of 0.57 weeks compared to the mothers aged 31 to 35. The fact that the difference was very small and the difference seen between the two groups was not significant (p=0.46) explains the unexpected result. Logistic regression however could not associate maternal age with exclusive breastfeeding durations. While the mean differences in

this study showed that duration of exclusive breastfeeding increased as maternal age rose the OR showed that there was no association with exclusive breastfeeding. Similar results were seen with a study in Iran, who examined breastfeeding factors to determine exclusive breastfeeding. They also found that exclusive breastfeeding was not related to the mother's age (Koosha, Hashemifesharaki & Mousavinasab, 2008). However other literature has seen associations with maternal age and exclusive breastfeeding. Evidence suggested that maternal age was associated with mother's level of breastfeeding, as Chye, Zain, Lim and Lim (1997) found, after sampling 500 Malaysian women that mothers older than 27 years were 1.48 times more likely to exclusively breastfeed. A UK study found that exclusive feeding rates were higher among mothers aged 30 and over (Kelly and Watt, 2004).

There are many reasons behind why younger mothers do not breastfeed. It may be that younger mothers are 'embarrassed' to breastfeed. Within the UK societal the embarrassment to breastfeed in public is a determining factor for mothers not to consider breastfeeding (Stewart-Knox, Gardiner and Wright, 2003). This emotion undermines the confidence to breastfeed and in particular young mothers can be considered 'disgusting' or 'dirty' (Iniechen, Pierce and Lawrenson, 1997) as revealing the breast and nipple is often viewed a 'rude'. McInnes, Love and Stone (2001) researched the predictors of breastfeeding intentions, they found that the average age of woman who did not intend to breastfeed was 24.9 years, which could be associated with maternal attitude. One U.S study reported that breastfeeding was strongly associated with maternal attitudes (Dungy, Losch and Russell, 1994)

Younger mothers were also more likely to be brought up in a 'formula culture' and so do not seem convinced that the method of feeding matters significantly, as formula feeding is viewed as an acceptable and accessible alternative to breastfeeding (Smith and Tully, 2001). Young people commonly perceive that breastfeeding implies

social isolation, restricted freedom and public disapproval (Stewart-Knox, et al, 2003).

5.5.2. Parity

Women who were having their first child, on average breastfed their child for 0.21 weeks longer than women who were breastfeeding a subsequent child, this mean difference however was not significant (p=0.84). Parity was analysed to see whether there was an association between parity for initiation, and breastfeeding duration, an association was found for the initiation of breastfeeding. Mothers who were having their first child were 1.9 times more likely to initiate breastfeeding than a woman who was having a subsequent child (p<0.05, 95% CI 1.14-3.16). Parity however was not a significant predictor of duration at 2 months and 6 months breastfeeding duration. This study shows that parity is an adequate predictor of breastfeeding initiation rather than duration, the Infant Feeding Survey (2005) found that across the UK, 79% of mothers having their first child breastfed their babies initially compared to 73% of mothers who were having second or later babies. In Scotland, Skafida (2008) found that 62.8% of mothers having their first child initiated breastfeeding, while only 58% of mothers having a later birth initiated breastfeeding. Parity in other research did not take effect until after a number of pregnancies, women having a third or later child were more likely never to initiate breastfeeding than lower parity women (Heck et al, 2006). Parity may have this effect on the initiation of breastfeeding as first time mothers are the recipients' of more messages about breastfeeding and support. Wright, Parkinson and Scott (2005) found that of the 92% of women that had initiated breastfeeding reported receiving advise and help with their first feed, while only 50% of women having a subsequent child did.

In this study women who were having their first child were on average exclusively breastfeeding their child for 1.28 weeks longer than the women who were exclusively breastfeeding a subsequent child, this mean difference was found to be significant

(p=0.015). In spite of this, logistic regression analysis could not find any association between parity and the duration of exclusive breastfeeding. Parity and its effects on breastfeeding are inconclusive with many conflicting results. In the UK Kelly and Watt (2004) observed that not only initiation, but exclusivity rates were higher among first time mothers. Parity has been shown to have the reverse effect as high parity was found to be positively associated with 6 months exclusive breastfeeding, a dose response relationship between parity and breastfeeding in previously documented literature (Lande et al, 2003; Al-Sahab, Tamim, Mumtaz, Khawaja, Khogali, Afifi, Nassif & Yunis, 2008) In Canada parity had a revere effect on mothers too, as previous pregnancies increased the likelihood of exclusively breastfeeding for 6 months (Al Sahab et al, 2010). This effect is believed to occur as mothers who have had more children are suggested to have an increased knowledge and self confidence from earlier experiences (Al Sahab et al, 2010).

5.5.3. Maternal Smoking Status

Smoking status was categorised into three groups; Smoker, Ex smoker and women that had never smoked. Women who smoked breastfed on average for the least amount of time at 4.33 weeks, ex smokers breastfed for 16.35 weeks and women who had never smoked breastfed for the longest duration, for an average of 18.88 weeks. The overall differences in means was significant ($p<0.001$). The different durations in breastfeeding between the mothers that smoked and ex smokers was significant ($p<0.001$), and mothers that smoked and mothers that have never smoked ($p<0.001$). The mean difference in duration of breastfeeding was also significant between the ex smokers and the mothers that had never smoked ($p= 0.009$). Logistic regression found that smoking did not deter mothers from attempting to breastfeed as initiation was not affected by maternal smoking status. However maternal smoking did have an association with the duration of breastfeeding. Mothers who had never smoked were 1.53 times more likely to breastfeed for 2 months compared to mothers

that smoked ($p<0.05$, 95% CI= 1.16-2.00). Maternal smoking continued to have an effect at 6 months as mothers who had never smoked were 1.59 times more likely to breastfeed for 6 months compared to smokers ($p<0.05$, 95% CI = 1.19-2.12). In this study initiation was not affected by maternal smoking, but this is not the case as in most research women who smoke are less likely to initiate breastfeeding (Edwards, Sims-Jones and Breithaupt 1998; Sayers, Thornton, Corcoran & Burk, 1995). Breastfeeding duration however was affected by maternal smoking in this study which is also seen in Haug et al (1998), who reported that women who did not smoke were twice as likely to continue to breastfeed at 6 months as women who smoked. Heck et al (2006) found that none smokers breastfed more often than smokers and a study that controlled for intended duration of breastfeeding, found that women who resumed daily smoking were almost 4 times more likely to stop breastfeeding earlier than women who abstained or smoked occasionally (Denis, 2006).

Exclusive breastfeeding observed the same pattern as breastfeeding duration. Women who had never smoked, exclusively breastfed for the longest time with an average of 7.31 weeks, the ex smokers on average exclusively breastfed for 6.39 weeks and the smokers on average exclusively breastfed for shortest time of only 1.14 weeks. The overall difference between the groups was significant ($p<0.001$). The difference in exclusive breastfeeding durations was significant between the smokers and the mothers that had never smoked ($p<0.001$), and the smokers and the ex smokers ($p<0.001$) but the difference in exclusive duration seen between the ex and never smokers was not significant ($p=0.226$). Logistic regression showed that maternal smoking status did not seem to effect exclusive breastfeeding duration but this is not so in other research. A study based in Liverpool observed that women practising exclusive breastfeeding were significantly ($p<0.001$) more likely not to smoke (Berridge, Hackett, Abayomi, Maxwell, 2004). Research also demonstrates a

'dose response' effect with smoking mothers; the heaviest smokers have the least likelihood of establishing exclusive breastfeeding (Ford et al, 1994).

There is a consensus that the link is a social rather than physiological one (Donath, Amir, & ALSPAC study team, 2003) although there is evidence that smoking diminishes hypothalamic activity and therefore, potential milk production and flow (Amir, 2001) however the strength of this inhibition is contentious. An epidemiological review of smoking and breastfeeding suggests that psychosocial factors are more likely to be responsible for the lower rate of breastfeeding among women who smoke (Amir and Donath, 2002). It is suggested that the difference is largely explained by lower rates of breastfeeding intention among smokers (Donath, Amir, & Team AS, 2004). Other possible explanations are that smokers are likely to perceive their milk supply as insufficient (Hill, & Aldag, 1996), are less health conscious than the general population or may have concerns about adverse health effects of smoking on their baby.

5.5.4. Education

Mothers who went onto further education after 18 years breastfed for an average of 21.78 weeks longer than the mothers who finished education at 18 years and younger, who on average breastfed for 14.47 weeks. Mothers with a higher education level breastfed for nearly twice the amount of time. This trend is also seen in exclusive breastfeeding duration. Mothers with a higher education breastfeed for an average of 10.94 weeks compared to an average of only 7.48 weeks for mothers with a lower education. The difference in mean duration was significant ($p<0.001$) as was the difference for exclusive breastfeeding duration ($p<0.05$). The differences seen show a very powerful association in logistic regression. Women who had a higher education attainment were 3.75 times more likely to initiate breastfeeding ($p<0.001$, 95% CI =2.03-6.93) than the mothers who had a lower education

attainment. This association also continued into the duration of breastfeeding. High educated mothers were 2.71 times more likely to breastfeed for 2 months ($p<0.001$, 95% CI= 1.59-4.62) than mothers with low education attainment. At 6 months highly educated mothers were 1.96 times more likely to breastfeed ($p<0.005$, 95% CI =1.05-3.67). Logistic regression revealed that women with a higher education attainment were over 3 times more likely to exclusively breastfeed at 2 months ($p<0.005$, 95% CI= 1.15-6.16).

This study is consistent with earlier UK research stating that rates of breastfeeding are higher in women with a higher education. The Infant Feeding Survey (2007) found a clear association between breastfeeding and education level. Across the UK mothers who had left full-time education at 16 or younger were the least likely to have breastfed (59%), while those who had left full-time education at 18 or older were the most likely to have breastfed (91%). At 6 months mothers with the higher level of education were more than 3 times as likely to be breastfeeding compared with mothers classified to the lowest education level. Scottish mothers with degrees or equivalent education qualifications had the highest breastfeeding rates (Skafida, 2008). Skafida (2008) also observed a linear positive trend between breastfeeding initiation and education; mothers with no qualifications resulted as having an 80% lower chance of initiating breastfeeding compared with those with degrees or equivalent, who were the most likely to initiate breastfeeding. Wright, Parkinson and Scott (2005) looked at many socio-economic factors that could predict infant feeding choices and found that only maternal education and area deprivation score were predictive of both initiation and continuance of breastfeeding. The association is not only confined to the UK, Heck et al (2006) found in a sample of Californian women that mothers with low levels of education were more likely not to initiate breastfeeding. Surprisingly this socio-economic divide is found in Sweden a county that has high rates of social expenditure, low income inequality, cost free access to

child health care, and where breastfeeding is regarded as the cultural norm (Galtry, 2003). Flacking, Wallin and Ewald (2007) looked at a sample of Swedish women and observed that a lower maternal education level constituted a significantly higher risk of weaning.

This study is also consistent with the Infant Feeding Survey (2007) on exclusive breastfeeding; an association was seen at birth and was evident at all ages up to 4 months in the survey. At week one 58% of mothers with the highest education level were exclusively breastfeeding compared with 30% of mothers with the lowest education level. By 4 months, 13% of mothers with the highest education levels were feeding exclusively compared with a mere 4% of mothers with the lowest education levels. In a Canadian study the main conclusion was that years of maternal education was the only significant socioeconomic variable for exclusive breastfeeding (Al-Sahab et al, 2010).

5.6. Education a factor for breastfeeding 'survival'

Education attainment was found to be a factor of breastfeeding survival. Women who have a higher education continue to breastfeed for longer when they start to breastfeed compared to women from a lower education, who stop breastfeeding much more quickly over the 6 months ($p<0.05$). The first few weeks see the biggest cessation rates for the whole 6 months, 33.8% of high education mothers cease breastfeeding during the first few weeks, and 51.3% of low education mothers cease breastfeeding. After this dramatic decline the high educated mothers gradually cease breastfeeding and survival steadily declines as a similar amount of women cease breastfeeding each week throughout the 6 months. The dramatic cessation rates continue to week 6 for the low education mothers, but a steady period of cessation can be seen for weeks 6 to 8. At week 9 a large amount of women stop breastfeeding, at weeks 13 to 17 no mothers stopped breastfeeding, from then on a

steadier period of breastfeeding cessation occurs. Mothers from the Infant Feeding Survey (2007) showed similar trends in survival, mothers with the highest education level continue to breastfeed for longer when they start to breastfeed their child, at 6 weeks 75% of mothers who left school at 18 or over were still breastfeeding compared with 44% of those who left school at 16 or earlier.

A similar trend is seen for exclusive breastfeeding; women who have a higher education survive longer when they start to exclusively breastfeed, whereas women from a lower education stop exclusive breastfeeding much more quickly over the 6 months ($p<0.05$). Exclusive breastfeeding sees very similar cessation rates as breastfeeding; the first few weeks see the highest risk of stopping exclusive breastfeeding. The median value shows the stark contrast between the two groups of mothers, it only takes 5 weeks for 50% of the lower education mothers to cease exclusive breastfeeding, whereas it takes double the time, 10 weeks for 50% of the women with a high education to cease exclusive breastfeeding. A steady decrease in cessation is seen throughout the 6 months for high education mothers but a surprisingly high amount of mothers cease exclusive breastfeeding in week 20. Unexpectedly mothers with a lower education are at lower risk of stopping exclusive breastfeeding at a week earlier than women with a higher education attainment. This studies exclusive survival results follow similar trends as the Infant Feeding Survey (2007). At 2 weeks 65% of mothers with the highest education level who fed exclusively at birth were still feeding exclusively compared with 48% of mothers with the lowest education level. At 4 months mothers with the highest education level were twice as likely as mothers with the lowest education level to be still breastfeeding exclusively.

An Australian study found no socio-economic difference in breastfeeding; it claimed that when overall breastfeeding prevalence exceeds 80%, there will no longer be any

socio-economic differences between mothers (Scott et al, 2006). This study however would disprove this; as despite having a 91.38% breastfeeding initiation rate, the study found very clear educational differences in breastfeeding rates.

Maternal education as a single indicator of socio-economic status is a powerful one. It not only reflects material resources but also noneconomic characteristics such as general and health related knowledge (Braveman, Cubbin, Egerter, Chideya, Marchi, Metzler, Posner, 2005). Its presence in this sample of women has had a powerful influence on their health behaviour; as women who have spent an extended time in formal education chose to initiate breastfeeding, to breastfeed for longer and to exclusively breastfeed their child. A high level of maternal education seems to help mothers understand the health benefits of breastfeeding, as they may be able to educate themselves on further topics such as infant nutrition and perhaps more likely to search out this information; knowledge of the benefits of breastfeeding has been shown to predict breastfeeding (Chezem, Friesen, Boettcher, 2003) possibly the high level of education gives mothers the confidence to attempt to breastfeed their child.

The relationship between this socio-economic variable could be explained by mediating cognitive-emotional factors (Flacking et al, 2007). It is suggested that socio-economic disadvantaged groups have fewer personal resources to cope with strenuous life situations (Gallo & Matthews, 2003). This could help explain the reasoning behind the association of education with breastfeeding survival; mothers with a lower education level, who start to breastfeed, stop much more quickly, as they might not have those personal resources to cope with the problems that occur during breastfeeding. Another explanation for the association might be that the disadvantaged groups suffer from disrespect from others, which could cause feelings of inferiority and powerlessness (Gallo & Matthews, 2003). A study by Starrin and Johnson (2006) concluded that a combination of socio-economic hardships and

shaming experiences highly increased the risk of depression, nervousness and impaired health. Perhaps the mothers in this study with a low educational attainment had experienced more shaming compared with the educationally advanced mothers, which would result in more negative stress and fewer resources to cope with breastfeeding.

5.7. Loss of exclusivity

More than half (56.46 %) of mothers who exclusively breastfed at birth lost exclusivity by the introduction of whey formula. Whey formula was the most common formula/ liquid mothers chose to first introduce after breast milk. 91.4% of mothers in the low education group who exclusively breastfed at birth lost exclusivity to whey formula, compared to 78.66% of mothers in the high education group who chose to introduce whey formula first after breast milk. The 2005 Infant Feeding Survey (Bolling et al, 2007) looked into the loss of exclusivity and found that an even larger proportion of mothers (64%) lost exclusivity by giving their baby, formula. The lower proportion seen in this study is probably explained by the different demographics of each study population. This study contained a large proportion of mothers who completed and continued education at 18 years compared to the Infant Feeding Survey. Results from this study and the Infant Feeding Survey show that women from a higher educational background are less likely to introduce formula and more likely to introduce solids after breast milk.

How exclusivity was lost also had an effect on how long the mothers exclusively breastfed their child. With mothers first introducing whey formula on average exclusively breastfeeding for a shorter amount of time (4 weeks) compared to mothers who introduced solids (18 weeks). These findings illustrate the fact that there are two groups of mothers who stop exclusive feeding. One group of mothers stop feeding exclusively after a relatively short period because they introduce formula

milk, which is either replacing or supplementing breastfeeding; while another group of mothers stop feeding exclusively at around the 4 months because they wean their baby at this age. What are interesting about these results are the two time points at which exclusivity was lost. It reveals the time when mothers need support the most. At the 1 month stage the importance of continuing exclusivity and explaining the health benefits to mothers may help to support them and so hopefully continue to breastfeed exclusively. At 4 months teaching mothers about weaning but continuing to have breast milk as the main source of nutrition for the infant and that the introduction of solids should 'supplement' breastfeeding would help improve general partial breastfeeding rates. Discussions earlier in the introduction (section 2.2.) showed that the health benefits of breastfeeding can be seen in infants who have been partially breastfed. The UK as a whole is a formula feeding nation, and so surely any type of breastfeeding that improves an infant's health would be seen as a step in the right direction. It could be argued that as a developed country with such low breastfeeding rates would it be more realistic to abandon the 6 month exclusive message or reduce it to 4 and just encourage mothers to continue to breastfeed alongside either formula or solids?

5.8. Implications

Ominously the results of this study reveal, that infants who are already born with a socio-economic disadvantage will also lack the protective benefit of breastfeeding; a vivid example of the concept of 'cumulative disadvantage' (Wright et al, 2005). Breastfeeding in the disadvantaged socio-economic groups could reduce the health inequality infants are potentially at risk of. Breastfeeding could not only benefit an infant's immanent but also its distant future. Given the public health importance of breastfeeding and given the results of this study there is a need to provide better support for mothers with low education attainment. Looking at the results generally from a social aspect, it could be argued that an increased investment in formal

education could potentially address the low initiation, duration, survival and exclusivity rates in breastfeeding among women of a lower education attainment. However the reason why education attainment is so crucial is likely to be multifaceted and years of education could be capturing different unmeasured or immeasurable factors related to a mother's aspirations and beliefs about infant feeding (Skafida, 2008) indicating that investing in higher education is the unlikely solution. The resolution to this problem is improving health and health behaviour in the mothers with a low educational attainment through interventions, promotion and policy. To support breastfeeding effectively interventions must consider influences of society, cultural norms, clinical problems, the organisation of health services and the preparation of health professionals and others (NICE, 2005).

Rates of breastfeeding in this study show that only 1.3% of infants were exclusively breastfed at 6 months, and of that 1.3%, all were women from high educational backgrounds. Initiation rates were high, indicating that the biggest concern for the population is duration rather than initiation. Interventions should therefore try strategies that enable longer breastfeeding duration.

The Baby Friendly Hospital Initiatives are encouraging, a large study from Switzerland found that duration of breastfeeding was higher in women birthing in hospitals with good compliance with the Baby Friendly Hospital Initiative (Merten, Dratva and Ackermann-Liebrich, 2005). The UK has 55 full accredited Baby Friendly Hospitals out of a possible 466 UK maternity hospitals and primary care trusts (UNICEF, 2010). NICE has recommended that implementation of Baby Friendly Initiative across NHS Trusts should be a core and practical approach in the promotion of initiation and duration of breastfeeding (Dyson, Renfrew, McFadden, McCormick, Herbet & Thomas, 2006). The push to gain UNICEF Baby Friendly accreditation can only be a good thing in improving the UK's overall initiation and

duration rates. A study in the UK however found that UNICEF UK Baby Friendly Initiatives are likely to increase breastfeeding initiation but not duration and that other strategies are required to support UK mothers to breastfeed for the recommended duration (Bartington, Griffiths, Tate, Dezateux, Millennium Cohort Study Health Group, 2006).

A marked feature of this study was the rapid decline of breastfeeding over the first few weeks in mothers with a low education level. It has been researched that the main reasons mothers stop during these first few weeks are; babies rejecting the breast, painful breasts or nipples and perceived insufficient milk (Phipps, 2006; Wright et al, 2005). This suggests that many women are not receiving adequate information and skilled support when they leave the hospital. Women that are electing to breastfeed who are socio-economic disadvantaged (like the women in this study) are at risk of being isolated and unsupported in what has become an unfamiliar practice (Scott & Mostyn, 2003). Women who are socio-economic disadvantaged are likely to not know anyone who has breastfed or even anyone who was breastfed (Phipps, 2005). What needs to be adopted by the local NHS communities is a ‘Peer Support’ approach. Where woman who have personal, practical experience of breastfeeding can offer support to other mothers. As this kind of mother-to-mother support has been lost in a formula feeding culture.

A Cochrane review of breastfeeding support, demonstrated that peer support is effective in promoting any breastfeeding and in prolonging exclusive breastfeeding (Britton, McCormick, Renfrew, Wade & King, 2007). Peer support has been deemed beneficial for increasing rates of breastfeeding for women in socio-economic disadvantaged communities or those without a supportive culture or tradition of breastfeeding who may be particularly susceptible to early weaning (Milligan, Pugh, Bronner, Spatz, & Brown, 2000). Women should be targeted at antenatal

appointments, and ‘screened’ for factors that could decrease breastfeeding duration such as level of education and would benefit from a peer support program.

Building a culture and tradition of breastfeeding within what has become a strong formula-feeding population is not going to be easy. Mothers need to be properly prepared for the time and effort that needs to be committed to breastfeeding and sequentially, the national and local NHS systems need to commit to providing support.

Conclusions

This study provided important information on how maternal education affects the level of breastfeeding in mothers. The evidence presented from this study supports the hypothesis that a low socio-economic maternal status will reduce breastfeeding duration and exclusivity. The observation that maternal education level can predict whether a mother will initiate and continue breastfeeding and its exclusivity is not new to public health literature. What this study has done is highlight the prominent problem that still exists in our society, and proves that maternal education is a practical and forceful component through which to explain and understand differences in breastfeeding initiation, duration and exclusivity. Understanding that maternal education is a strong factor related to breastfeeding means that supporting mothers, who come from low educated backgrounds, would help reduce socio-economic based health inequalities in both childhood and adulthood, which could potentially achieve a broad public health impact.

This study has also identified crucial rates of excusive breastfeeding. Information regarding exclusivity is particularly useful as it can be used to inform the health services to see if recommendations are being met. Only 1.3% of mothers exclusively breastfed their child for the recommended 6 months, revealing that radical shifts in practice and policy in the health service and across society as a whole need to happen to meet recommendations. The promotion of breastfeeding is vital if the rates of exclusive breastfeeding are to be improved. In Sweden, where initiation and duration of breastfeeding is substantially higher than in the UK, multi-faced interventions have been implemented nationally for the last 20 years (Protheroe, Dyson, Renfrew, Bull, & Mulvihill, 2003). This can be seen to indicate that promotional effects are well worthwhile and that improvements in exclusive breastfeeding rates can be made.

The study's results on timing and how exclusive breastfeeding ceased, suggested that there is a need to properly prepare mothers for the time commitment of breastfeeding, and highlighted the best timing for support strategies. The results also raised the question whether it is realistic to expect mothers to maintain exclusive feeding as opposed to partial breastfeeding.

Further detailed research is required into the obstacles that prevent the prolonged duration of exclusive breastfeeding, particularly among lower educated mothers using a large sample that can be extrapolated confidently to the broader population. Further reseach needs to gain qualitative data on mothers breastfeeding experiences at 1 and 4 months, which could help health practitioners who work closely with breastfeeding mothers in offering pratical and realistic support to improve exclusivity duration.

Public Health Implications

- The government/NHS need to rethink breastfeeding guidelines: Is 6 months of exclusive breastfeeding an unrealistic goal for a society with such low exclusivity rates.
- More needs to be done to improve duration rates in the UK. At 1 month mothers should be offered peer support and advice: the importance of continuing exclusivity and explaining the health benefits may help to support mothers to continue to breastfeed. At 4 months mothers should be offered peer support and advice: teaching mothers about weaning but continuing breast milk as the main source of nutrition, and that the introduction of solids should 'supplement' breastfeeding.

Word Count: 16,993

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Appendices

Appendix A: Information Sheet

Winchester and Eastleigh NHS
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PIFA

Prevalence of Infant Food Allergy

Participant Information Sheet

You are being invited to participate in our study about food allergies. Before you decide it is important you understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this.

What are food allergies?

Food allergies are an adverse response to foods, which can show up in many different ways. Some people get stomach cramps, vomiting or diarrhoea, others break out in a rash, some have trouble breathing, some others become seriously ill. The cause of food allergies is unknown but is thought to be a combination of immunity, genes and the environment.

Around 11-26 million people in Europe suffer from food allergies. This figure is thought to be increasing, the variety of foods that cause allergies and the frequency of severe reactions are also increasing.

What is the purpose of the EuroPrevall study?

The purpose of this study is to improve the management and care of people with food allergies and also investigate if food allergies can be prevented.

PIFA is part of a large European Union-funded project called EuroPrevall, which will identify the prevalence, cost and cause of food allergy across Europe. This part of the project focuses on young children in Europe and will be looking at why some individuals develop allergies whilst others do not.

In addition to this Europe-wide aim, PIFA will also be looking at infant feeding practises in the first year of life. This is being done to advise the government and the NHS about how children are actually being fed in their first year of life.

Why have I been chosen?

A total of 12 000 babies and their families will be participating in the study in Iceland, Great Britain, Germany, Poland, Greece and Spain. We will be recruiting 1500 children born in Winchester and will follow them to 30 months of age.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part you will receive this information sheet to keep and will be asked to sign a consent form. The first part of the consent form (Part A) asks for your consent to participate in the study. The second part (Part B) asks for permission to store blood samples for use

in future research into allergic diseases (eg food allergy and asthma). They will only be used for studies approved by the Local Research Ethics Committee. These blood samples are known as linked anonymised samples. This means that the researchers who use the samples will not know whose samples they are. You will receive a copy of the signed consent form. If you do decide to take part you can end your participation at any time, without giving any reason, and without any consequences for further care and treatment of your child.

Can my baby participate in this study?

Most babies born after 34 weeks of pregnancy will be eligible for the study.

What will happen in the study?

Initial interview: After you have given your consent to participate in the study, you will be asked in an initial interview about your pregnancy, whether you or the baby's father have allergies, whether any siblings of your expected baby have allergies and about your home environment.

What will happen in the study continued…..?

After your baby is born: At your baby's birth, blood will be taken from the baby's umbilical cord (after the cord is cut, so this will not cause any pain or discomfort to you or your baby). Some blood will be stored in Southampton and some will be sent to Charité University Medical Centre in Berlin, Germany, to be analysed for the presence of food-specific allergy antibodies. In addition, a small sample of your blood will be collected. Some will be stored in Southampton and some will be sent to the Medical University of Vienna, Austria for storage and use in a future part of the study. A couple weeks afterwards, we will also ask you about your child's birth, their early feeding and their sleeping environment over the phone.

Telephone questionnaires: You and your baby will be followed in the study over the next 30 months, through 3 simple interviews (either over the telephone or face-to-face) when your child is 1 and 2 years old.

Food diary: For the first year of the study you will be asked to complete a record of what your baby eats.

If your baby develops signs and symptoms of food or other allergies: We would like to interview you to find out what symptoms your baby is having, what foods he/she is eating, and your house environment. You will also be asked to bring your baby to the research clinic in Southampton for a physical examination by a specialist paediatric allergy nurse.

At this visit a small blood sample will be collected as above and analysed for allergy to specific foods. A swab from your baby's nose may be taken (if you consent to this) and will be sent to the National and Kapodistrian University Hospital in Athens, Greece. We will also wish to collect a sample of the baby's parent's blood at this time to look at the genes that may be related to developing food allergies.

Your child will receive skin-prick testing for allergy to common foods or foods that you suspect cause a problem. Your child will be offered a food challenge test, under the supervision of a paediatrician, to see if the food is definitely causing the problem. This kind of challenge is part of routine medical care.

Control (well) children: In this study children who develop symptoms of food or other allergies (called "cases") will be compared to those who do not (called "controls"). Children develop allergies at different times so a baby with no allergy problems in the first few months of life may develop such allergies later, and so they would change from being a "control" infant to being a "case" infant. It is important to identify such children, by following some children with no obvious allergy symptoms. If your baby does not develop any symptoms of food allergy, but their age matches that of a child who does develop symptoms, you may be asked to bring your child to the clinic for a physical examination by a specialist paediatric allergy nurse. This would include collecting a small amount of blood from your child and a nasal swab sample as above. This assessment of children with no symptoms does not include skin prick testing. We will also collect a sample of the baby's parent's blood at this time to help us look

at the genes that may be related to developing food allergies.

Storing blood samples: We would like to store some of the samples for use in further studies into allergies (eg food allergy and asthma). We will only use them for studies whose protocols have been reviewed and approved by the Local Research Ethics Committee and only if you have consented to their storage.

Any samples taken will always remain your property. If you decide to change your mind about continuing in the study they will be destroyed or returned to you, according to your wishes.

What is a skin prick test?
A skin prick test is a standard medical test for food allergies. A drop of the liquid food will be put on the skin and then scratched with a small needle to see if a reaction occurs. The test is positive if a small wheal (like a nettle rash) is raised on the skin after 15 minutes. This is a safe, routine investigation.

What is a food challenge?

If your child has symptoms suggestive of a food allergy we would invite them for a food challenge. This is a standard test for evaluating food allergies. In a food challenge, your child would be given 2 meals on separate days. One would contain the food thought to cause the allergy and the other would have none of the suspected food in it, this is called a placebo. Neither you nor the physician will know which meal has the placebo or the food. Each meal will consist of a number of steps with increasing amounts of the foods. After each step, your child would be carefully observed and vital medical measurements taken to see if any reaction occurs. The challenge will be stopped if any reaction occurs or if there are no allergic symptoms after a normal amount of the food is eaten. Your child will be observed in the research clinic for about 2 hours after the challenge has finished.

What are the side effects of any treatment received when taking part?

Anaesthetic cream will be used to numb the skin before the blood test. When blood is drawn, you or your child will feel a little discomfort. A small bruise might form in that area or very rarely someone may faint.

If your child participates in a food challenge, the expected reactions are itching, stomach upset, hives, or worsening of eczema. Severe reactions such as anaphylaxis are rare but all the medicines and equipment to treat them will be available at all times during the challenge. A trained paediatrician closely supervises all challenges.

What must I do in the study and how much time and energy will be involved?

A summary of your involvement in the study is detailed in the box below.

Initial questionnaire (30 minute interview)
↓
Blood from mother and cord immediately after birth
↓
Birth questionnaire (15 minutes via telephone)
↓
Brief food diary during first year of life
↓
1 year questionnaire (30 minutes via telephone)
↓
2 year questionnaire (30 minutes via telephone)
↓
2½ year questionnaire (30 minutes via telephone)

Additionally we ask you to:

- notify us if your child develops signs and symptoms of allergies and bring them to the clinic for evaluation including a skin prick test and blood test (60-90 minute visit). A food challenge would be used to confirm any possible food allergy.
- bring your child to clinic for evaluation and a blood test if they are chosen as a healthy control for a child with food allergy (30 minute visit).

What are the advantages to participating in this study?

Experts in the field of allergies will follow your baby. These experts will evaluate any signs or symptoms of allergies that your baby may develop. This should increase the quality of your child's health care and the speed of a possible diagnosis of allergy in children who have been healthy and are being followed up as "controls". Your participation in this study will have absolutely no negative influence on the normal care of your child.

What are the possible disadvantages and risks of taking part?

The interviews and appointments will be extra to your routine clinic appointments with your midwife and health visitor but we will schedule them with you to minimize your inconvenience. The blood samples may cause short-lived discomfort. The food challenges may cause an allergic reaction but they will be performed under the constant supervision of experienced paediatric medical and nursing staff.

Are any medicines or GM products being used in this trial?

No, this study does not involve testing any new medication or procedure or any GM food or product.

What if new information becomes available?

Because this study is not testing any product or medicine, we do not anticipate any major problems with completing it successfully. However, new information may become available. This project has both a local advisory committee and an international advisory committee, both made up of experts in the area. They meet regularly and decide if any new findings would have an impact on the study and what needs to be done to take account of the new findings. An annual report must be also submitted to the local ethics committee in Winchester who will continue to monitor the study.

What happens when the research study stops?

Although this study is only following up the children until they are 2½ years of age, we would like to be able to continue to follow them up after this time. This would be as part of a separate study approved by the Research Ethics Committee. You would not be under no obligation to participate in any future study.

Who is responsible for the study?

The University of Southampton is responsible for the study in the UK. Dr Graham Roberts is the Consultant Paediatrician with overall responsibility for the study.

What if something goes wrong?

If you have any questions or concerns, please contact Dr Roberts on 02380 794230 (24 hr answer-phone available.

If you have questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact the Research and Development Coordinator, Southampton General Hospital (02380 79 8918). Alternatively, the normal NHS complaints mechanisms will be available to you.

The study is being sponsored by Southampton University Hospitals NHS Trust.

Will my taking part in this study be kept confidential?

If you consent to take part in the research clinical research staff may inspect your medical records. However, the personal and medical data of you and your child will be handled confidentially and respectfully by the study team. All the particular Data Protection laws of the UK will be followed.

The data collected will be coded with your child's study number and sent over a secure Internet connection to a study database. No data will identify you or your baby by name.

Should you decide to participate in the study, we would like to inform your GP of your participation but we will ask your consent to do this.

What will happen with my answers in the interviews, the medical data and the dietary intake information?

Your baby's personal data (name, address, date of birth, sex) will be written on the informed consent sheet and stored locked in the study office, after being entered in electronic form in a separate computer database, along with a corresponding study patient number. Only the study paediatrician or named study personnel will have access to this database.

Your answers to the questions during the interviews and the findings of the medical examination will be identified only by the

study number. Only this information will be entered into a common database for the entire project.

The food intake information will only have the study patient number on it as identification.

An experienced researcher from the study-coordinating centre may check your and your child's hospital notes to confirm that the study is being carried out correctly. Your name, however, will not be disclosed outside the hospital.

What will happen to the results of the research study?

The results from both the UK aspect of the study and the Europe wide study will be published in scientific papers. They will also be available on the study website and will be presented to study participants in meetings and by newsletter.

Who is organising and funding the research?

The Europrevall Project is being coordinated by Charité Hospital in Berlin, Germany. The UK part is being funded by the UK's Food Standards Agency. Other aspects have been funded by the European Union.

Who has reviewed the study?

The overall study was reviewed by medical and scientific experts commissioned by the EU and by the research ethics committee at Charité Hospital, Berlin. The study activity in Winchester has been specifically reviewed again by the North and Mid Hampshire local research ethics committee at Winchester.

Contact for further information

We hope that we have been able to answer your questions about this study. Your decision to participate in this study is entirely voluntary. Please take as much time as you need to consider joining us in this important research. If you have further questions, please contact:

Lesley Gudgeon (Study Co-ordinator) on 023 8079 4230 or lag@soton.ac.uk

Kate Grimshaw (Study Research Dietician) on 023 8079 4887 or kecg@soton.ac.uk

Study website: www.pifa.soton.ac.uk

Thank you for taking time to read this information sheet.

Appendix B: Consent Form

Winchester and Eastleigh NHS
Healthcare NHS Trust

Study Number: 05/Q1703/34
Patient Identification Number:

CONSENT FORM

Title of Project: Prevalence of Infant Food Allergy (PIFA) Study
Name of Researcher: Dr Graham Roberts

Please initial box if you agree with each section.

PART A

1. I confirm that I have read and understand the information sheet dated 14/08/05 (version 2) for the above study and have had an opportunity to ask questions. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected. ☐
3. I understand that sections of any of my medical notes may be looked at by responsible individuals from regulatory authorities where it is relevant to my taking part in this study. I give permission for these individuals to have access to my records. ☐
4. I agree to complete dietary intake records for my child during the first year of the study ☐
5. **I agree to the testing of my child's blood for genetic markers for food allergy.** ☐
6. **I agree to my General Practitioner being informed about my participation in this study.** ☐
7. **I agree to take part in the above study.** ☐

PART B: Linked anonymised samples gifted for storage and use in future studies:

1. I give permission for samples from myself and my child to be stored (potentially for many years) for possible use in future research studies. **Future studies will be reviewed and approved by a Research Ethics Committee prior to my sample being used.** I understand that these studies may not directly benefit the health of myself or my child.

You can alter these decisions at any stage by letting the researcher know.

a) I give permission for the sample to be used for investigations of medical conditions relating to allergic diseases (eg food allergy, asthma, eczema, hay fever). ☐

b) I give permission for the sample to be used for genetic research aimed at understanding the genetic basis of allergic diseases (eg food allergy, asthma, eczema, hay fever). ☐

c) I give permission for a member of the research team to look at my medical records, to obtain information on allergy. I understand that the information will be kept confidential. ☐

_____	_____	_____
Name of Mother	Date	Signature
_____	_____	_____
Name of Person taking consent (if different from researcher)	Date	Signature
_____	_____	_____
Researcher	Date	Signature

1 for patient; 1 for researcher; 1 to be kept with hospital notes Participant Consent Form V2 14.08.05
REC 05/Q1703/34

Appendix C: Instructions on how to complete the food diary/ Food Diary

Infant Food Diary Record for Prevalence of Infant Food Allergy (PIFA) Studv

Instructions for completion

- Simply write down anything your infant eats or drinks e.g. a breastfeed, potato and carrot puree etc.
- Please give details of what is given (eg ingredients in a homemade dish or brand and type of commercial food).
- On week 4 of each month (indicated by the blue sheet) please give more details of amount taken eg, 4fl oz, formula milk (stating brand and type), 3 teaspoons potato and parsnip puree etc.
- Try to write down when things are taken so foods aren't forgotten.
- For most days it should take only a minute or two to complete, for the 4th week in every month we would like a little more detail but we DO NOT require you to weigh or measure foods. Household measures or packet size is plenty of information.
- Feel free to contact Kate Grimshaw the study's research dietitian if you have any questions. Her number is 023 8079 4230.
- Thank you for completing these diaries.

LREC number 05/Q1703/34
Version 2
05.08.05

Appendix D: Food Diary Study Number 1800628 Diary Wk 1 / Child's age in wks =

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Morning							
Afternoon							
Evening							

Night							

Study Number 1800628 Diary Wk 2 / Child's age in weeks =

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Morning							
Afternoon							

Evening							
Night							

Study Number 1800628 Diary Wk 3 / Child's age in weeks =

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Morning							

Afternoon							
Evening							
Night							

Study Number 1800628 Diary Wk 4 / Child's age in weeks =

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday

Morning							
Afternoon							
Evening							
Night							

Appendix E: Baseline Questionnaire

Form 2: Questions for the mother

Please fill in EuroPrevall–ID first:

		0				

EuroPrevall – ID

A. Your new family

1.	Is your baby…?	○ a boy ○ a girl
2.	Is your baby…?	○ single birth ○ one of twins ○ one of triplets If a twin or triplet(s) is also recruited, please fill in Baseline Questionnaire Form 7 Multiple Birth
3.	Do you have **any** other children?	○ Yes, blood **and** non-blood related to the new baby ○ Yes, only **non-blood** related to the new baby (Complete 4 and go to 26) ○ Yes, **only blood** related to the new baby (Go to Q5) ○ No (Go to Q26)
4.	How many children are living in the household who are **not blood-related** to the new baby?	☐☐ **non-blood** related children in household
5 - 25	If you have children who are **blood-related** to the new baby, starting with the oldest **blood-related** child, please give their age, sex (M or F) and relationship to your new baby.	

Child	Age(years)		Sex		Relationship to baby	
Child 1			○ M	○ F	○ Full sibling	○ Half sibling
Child 2			○ M	○ F	○ Full sibling	○ Half sibling
Child 3			○ M	○ F	○ Full sibling	○ Half sibling
Child 4			○ M	○ F	○ Full sibling	○ Half sibling
Child 5			○ M	○ F	○ Full sibling	○ Half sibling
Child 6			○ M	○ F	○ Full sibling	○ Half sibling
Child 7			○ M	○ F	○ Full sibling	○ Half sibling

B. Your delivery

Did you receive **antibiotics**….		
26.	…during your delivery?	○ Yes ○ No ○ Don't know
27.	If yes, name of antibiotic 1	
28.	Name of antibiotic 2	
29.	Name of antibiotic 3	
30.	…after your delivery?	○ Yes ○ No ○ Don't know
31.	If yes, name of antibiotic 1	
32.	Name of antibiotic 2	
33.	Name of antibiotic 3	
34.	If you delivered in a hospital, was there anything that interfered with your ability to breastfeed your baby, (because the baby was in special care, given light treatment or for other reasons)?	○ Yes ○ No ○ Not applicable

35.	Was your baby given anything other than breast milk to drink **in the first week**?	○ Yes (please explain in ○ No (Go to 45) ○ Don't know (Go to 45)	
If yes, **what** was your baby given to drink **in the first week**?			
36.	Sugar water	○ Yes ○ No	
37.	Normal cow's milk formula	○ Yes ○ No	38. If yes, **name** formula _____
39.	Normal soy milk formula	○ Yes ○ No	40. If yes, **name** formula _____
41.	Hypoallergenic (<u>modified</u>) formula	○ Yes ○ No	42. If yes, **name** formula _____
43.	Other	○ Yes ○ No	44. If yes, please specify _____

45.	What was your **height** before your pregnancy?	☐☐☐ cm
46.	What was your **weight** before your pregnancy?	☐☐☐ kg

C. Questions about your pregnancy

During your pregnancy, did you eat, increase, avoid or limit your intake of certain foods or drinks for any reason?

From the list below, please indicate your eating habits during your pregnancy.

		Did you eat this food?		**In comparison to your eating habits before your pregnancy, did you…?**			
				…eat the same amount?	…eat an increased amount?	…limit your intake?	…avoid it altogether?
47.	Milk and other dairy products	○ Yes	○ No	48 ○	○	○	○
49.	Soy products (e.g. milk, tofu, sprouts)	○ Yes	○ No	50 ○	○	○	○
51.	Eggs	○ Yes	○ No	52 ○	○	○	○
53.	Peanuts	○ Yes	○ No	54 ○	○	○	○
55.	Tree nuts	○ Yes	○ No	56 ○	○	○	○
57.	Seeds (e.g. sesame, sunflower, poppy)	○ Yes	○ No	58 ○	○	○	○
59.	Fish	○ Yes	○ No	60 ○	○	○	○
61.	Shellfish	○ Yes	○ No	62 ○	○	○	○
63.	Cereals and cereal products	○ Yes	○ No	64 ○	○	○	○
65.	Vegetables	○ Yes	○ No	66 ○	○	○	○
67.	Legumes	○ Yes	○ No	68 ○	○	○	○
69.	Fruit	○ Yes	○ No	70 ○	○	○	○
71.	Meat and meat products (including poultry)	○ Yes	○ No	72 ○	○	○	○
73.	Coffee and tea	○ Yes	○ No	74 ○	○	○	○
75.	Alcohol	○ Yes	○ No	76 ○	○	○	○
77.	Confectionaries (e.g. chocolate, candies)	○ Yes	○ No	78 ○	○	○	○
79.	Fish liver oil	○ Yes	○ No	80 ○	○	○	○
81.	Probiotics (specify brand) 82_____	○ Yes	○ No	83 ○	○	○	○

84.	If other, please specify _____		85 ○ ○ ○ ○
86.	If other, please specify _____		87 ○ ○ ○ ○

88.	In the **last 3 months** of your pregnancy, did you especially prefer or avoid specific food items?	○ Yes ○ No →(Go to Q 95)
	If yes, which foods did you **prefer**?	
89.	Name of food 1	_____
90.	Name of food 2	_____
91.	Name of food 3	_____
	If yes, which foods did you **avoid**?	
92.	Name of food 1	_____
93.	Name of food 2	_____
94.	Name of food 3	_____

Do you suffer from…?				
95.	…asthma	○ Yes	○ No	○ Don't know
96.	…allergies (airway, food, eczema)	○ Yes	○ No	○ Don't know
97.	…diabetes mellitus (present before pregnancy)	○ Yes	○ No	○ Don't know
98.	…rheumatoid arthritis	○ Yes	○ No	○ Don't know
99.	…Crohn's disease	○ Yes	○ No	○ Don't know
100.	…ulcerative colitis	○ Yes	○ No	○ Don't know
101.	…high blood pressure (present before pregnancy)	○ Yes	○ No	○ Don't know

102.	…thyroid disease	○ Yes	○ No	○ Don't know
103.	If other, please specify _____			
104.	If other, please specify _____			

During your pregnancy, did you suffer from…?				
105.	…pre-eclampsia (high blood pressure, oedema, and/or protein in urine)	○ Yes	○ No	○ Don't know
106.	…high blood pressure (with no oedema or protein in urine)	○ Yes	○ No	○ Don't know
107.	…gestational diabetes	○ Yes	○ No	○ Don't know
108.	…urinary tract infections	○ Yes	○ No	○ Don't know
109.	…flu or fever episodes	○ Yes	○ No	○ Don't know
110.	If other, please specify _____			
111.	If other, please specify _____			

Supplements:

When you were pregnant, did you take any of the following…?

		Yes, regularly at least several times a week	Yes, for a specific episode	Yes, occasionally	No
112.	Folic acid	○	○	○	○

113.	Multivitamins	○	○	○	○
114.	Vitamin D (specifically)	○	○	○	○
115.	If yes, what was the dose of Vitamin D?	☐☐☐☐ I.U.			
116.	Fish oil capsules	○	○	○	○
117.	Other supplements (please specify) _____	118. ○	○	○	○
119.	Other supplements (please specify) _____	120. ○	○	○	○

Medications:

When you were pregnant, did you take any of the following…?

		Yes, regularly at least several times a week	Yes, for a specific episode	Yes, occasionally	No
121.	Antibiotics	○	○	○	○
122.	Aspirin or paracetamol	○	○	○	○
123.	Anti-inflammatory, e.g. ibuprofen, nurofen	○	○	○	○
124.	Medications for reflux disease	○	○	○	○
125.	Medications for diabetes mellitus	○	○	○	○
126.	Medications for asthma	○	○	○	○
127.	Medications for high blood pressure	○	○	○	○
128.	Medications for other conditions	○	○	○	○

Alternative medicines, e.g. homeopathic, plant, etc. (please specify)

When you were pregnant, did you take any of the following…?

		Yes, regularly at least several times a week	Yes, for a specific episode	Yes, occasionally	No
129.	(Name of medicine) _____	○	○	○	○
130.	(Name of medicine) _____	○	○	○	○

131.	(Name of medicine) _____	○	○	○	○

Smoking					
132.	Do you smoke?	○ Yes	○ No, **ex-**smoker	○ No, **never** smoked →(Go to Q 137)	
133.	(if smoker or ex-smoker) How many years in total did you smoke?	☐☐ years			
134.	Did you stop smoking or reduce the number of cigarettes you smoked when you found out you were pregnant?	○ Yes, stopped completely	○ Yes, reduced the number of cigarettes	○ No, continued to smoke at the same level	○ I had stopped smoking before I became pregnant →(Go to Q 137)
135.	About how many cigarettes a day were you smoking **before** you became pregnant?	☐☐ cigarettes/day **If the number varied please give an average.**			
136.	About how many cigarettes a day were you smoking **while** you were pregnant?	☐☐ cigarettes/day **If the number varied please give an average.**			

137.	Does anyone else smoke at your house?	○ Yes ○ No→(Go to Q140)
138.	How many cigarettes per day are smoked **inside** your home?	☐☐ cigarettes/days **If the number varied please give an average.**
139.	How many cigars or pipes per day are smoked **inside** your home?	☐☐ cigars, pipes, etc **If the number varied please give an average.**
140.	Were you <u>regularly</u> exposed to **passive** (secondhand) cigarette smoke while you were pregnant, e.g. at work or in a pub?	○ Yes ○ No

D. Sociodemographics

141.	How old are **you**?	☐☐ years old			
142.	How old is the baby's **FATHER**?	☐☐ years old			
143.	What is the **highest** level of education **you** have completed?	○ did not complete basic education (<10-12 years)	○ completed basic education (10-12 years)	○ Junior college/ Vocational training	○ **University or** college

144.	What is the **highest** level of education **the baby's FATHER** has completed?	○ did not complete basic education (<10-12 years)	○ completed basic education (10-12 years)	○ Junior college/ Vocational training	○ **University or** college
145.	What is (was) the full title of **YOUR** current (or last) main job? (For example: teacher, shop assistant, state registered nurse, physician, car mechanic, computer programmer, management executive, attorney, etc.)	_____			
146.	What is (was) the full title of the current (or last) main job held by your baby's **FATHER**? (For example: teacher, shop assistant, state registered nurse, physician, car mechanic, computer programmer, management executive, attorney, etc.)	_____			

147.	What is **your** ethnic group?	○ Caucasian (white)	○ Asian	○ African	○ Arabian	○ Other, including mixed
148.	If other, please specify	_____				
149.	What is the ethnic group of your **baby's father**?	○ Caucasian (white)	○ Asian	○ African	○ Arabian	○ Other, including mixed
150.	If other, please specify	_____				

151.	What is your post code?	☐☐☐☐☐☐☐☐	
152.	If you don't know your post code, in what suburb or town do you live?	_____	
153.	In what type of area do you live?	○ Urban →(Complete only Q 154)	○ Rural (population <5000) →(Complete only Q 155)
154.	If you live in an urban area, what is the approximate population of your city?	☐☐☐☐☐☐☐☐	
155.	If you live in a rural area, do you live	○	○ _____

	on a farm?	Yes No
156.	Do you live on a main road where heavy vehicles (trucks, buses) pass by?	○ Yes ○ No
How many **people** live in your household? (including the new baby)?		
157.	Number of adults	☐☐
158.	Number of children (< 18 years)	☐☐
159.	How many bedrooms does your home have, including baby's room and guest room?	☐☐
160.	Do you have any animals?	○ Yes ○ No (go to Q191)

161-190	If yes, please choose up to 5 animals from the list, list the number of each and where they are allowed (multiple answers possible)	

	Number of each		Where are they allowed?			
			Baby's bedroom	Living room	Kitchen	Only outside the house
Dogs			○	○	○	○
Cats			○	○	○	○
Birds			○	○	○	○
Rodents			○	○	○	○
Horses			○	○	○	○
Goats			○	○	○	○
Cows			○	○	○	○
Chickens			○	○	○	○
Pigs			○	○	○	○
Reptiles			○	○	○	○
Insects			○	○	○	○
Fish			○	○	○	○

191.	Are there any areas of mould in your flat or house?	○ Yes ○ No ○ Don't know

192.	What do you **usually** use to clean your kitchen work surfaces?	○ Non-bactericidal cleaning product ○ Bactericidal cleaning product ○ None of these ○ Don't know
193.	What do you **usually** use to clean the table where you eat?	○ Spray cleaner ○ Soap and water ○ Just water ○ None of these

194.	What main type of flooring is in the room where your baby will sleep?	○ Carpet ○ Wooden, laminate, parquet ○ Linoleum or vinyl tiles ○ Ceramic / terracotta tiles or stone ○ Sea-grass or coir-type matting ○ Other
195.	If other, please specify	_____

196.	What kind of mattress will your baby sleep on	○ Raw hair ○ Foam ○ Synthetic (other than foam) ○ Feather ○ Other
197.	If other, please specify	_____

198.	Will your baby share a bed with you?	○ Yes ○ No
199.	Does your baby's mattress have a plastic surface or cover?	○ Yes ○ No
200.	Will your baby lie on a sheepskin, either in bed or in the pram?	○ Yes ○ No

201.	**Please give the date when you completed this questionnaire.**	☐☐ DD ☐☐ MM ☐☐☐☐ YYYY

Appendix No F: GPower Calculations